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Region 4
345 Courtland Street, NE
Atlanta, GA 30308

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DRAFT

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Environmental Impact Statement

Occidental Chemical Company
Swift Creek Chemical Complex
Hamilton County, Florida

Resource Document
Volume III

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This Draft EIS concerns the issuance of an NPDES permit to Occidential Chemical Company for the construction of a new chemical plant in Hamilton County, Florida. The construction of the new Swift Creek Chemical Complex is part of a two-phased plan to increase the superphosphoric acid capacity of the north Florida phosphate fertilizer manufacturing complex. The facility will require approximately 50 acres for the plant and 275 acres each for a gypsum stack and cooling pond. Potential sources of pollution are air emissions (suflur dioxide, particulates, and fluorides), process water and nonprocess water. Impacts of emissions on air quality and surface and ground water were examined.

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Resource Document Volume III

2.8 THE SOCIOECONOMIC ENVIRONMENT IN WHICH OCCIDENTAL CHEMICAL COMPANY OPERATES IN NORTHERN FLORIDA

2.8.1 HISTORICAL TRENDS OF SOCIOECONOMIC VARIABLES

2.8.1.1 Introduction

This section contains a statistical picture of the past. Population, income, and employment patterns over the past five to ten years are examined. This information is currently available up through 1975 and, in some cases, through 1976. Housing characteristics in Columbia, Hamilton, and Suwannee counties are also examined, though the best information is found in the 1970 Census of Housing. Governmental activities are also examined, including local tax sources and local expenditures with much of the information being available through 1976. State tax collections are tabulated with special emphasis on the contribution of this three-county area to state tax collections. Finally, the importance of Occidental Chemical Company as an employer and taxpayer in this three-county area is discussed.

The Occidental facilities are located in Hamilton county and all new facilities will be located in this county, but Occidental's employees live within an approximate one hundred mile radius of the plant site and the direct impact of the plant is felt over this entire area. The bulk of the employees live within Columbia, Hamilton, and Suwannee Counties. For this reason Columbia and

Suwannee Counties are included in this analysis, as well as Hamilton County. Information on Duval County is given at the end of this section since the effects on Duval County will be through different channels than the effects on Columbia, Hamilton, and Suwannee Counties. Throughout, Duval County will be treated separately from the other three counties. In all cases, what has been happening to the State of Florida will be compared to what has been happening in these designated areas of Florida.

2.8.1.2 Historical Trends in Columbia, Hamilton and Suwannee Counties' Population

In terms of population growth, Florida has made remarkable strides in the last several decades. In 1930, Florida's population was lower than any other southeastern state, representing only 5.4 percent of the total population of the southeastern states. By 1970, Florida's population had exceeded every other southeastern state and represented 15.5 percent of the total southeastern population. Continuing this rapid growth into the 1970's, Florida represented 17.2 percent of the population of the southeastern states by 1974. It is estimated that the total population of Florida had grown to over 8.5 million by 1976. A comparison of Florida to other southeastern states is listed in Table 2.8-1.

Population within the local impact area (Columbia, Hamilton, and Suwannee Counties) has not increased as rapidly as the state of Florida from 1960 to 1974 as illustrated in Table 2.8-2. From 1960 to 1970, population within the local impact area increased by 13.7 percent while Florida's population increased 37.1 percent. The compounded average annual growth rates were 1.3 percent for the local impact area and 3.2 percent for the state. From 1970 to 1976 the state's population grew more rapidly than the population of the local impact area by a 25.9 percent to 15.6 percent margin. In 1960 the local impact area accounted for 0.9 percent of the state's population, but by 1976 the combined population of Columbia, Hamilton, and Suwannee Counties accounted for less than 0.7 percent of the population of Florida.

Within the local impact area over 50 percent of the population is concentrated in Columbia County. During the 1960's, Columbia's population grew at a rate of 25.8 percent while the population in Hamilton and Suwannee grew, respectively, at rates of 1.1 percent and 4.0 percent. However, during the 1970's, the population picture has changed slightly. From 1970 to 1976 Suwannee's population grew by 21.5 percent, while Columbia's population grew by 13.5 percent and Hamilton's population by 10.4 percent. From 1974 to 1976 the shift in the growth of the population was even more noticeable.

Columbia's population increased by less than one percent, while Suwannee and Hamilton's populations grew at rates of 7.2 percent and 4.9 percent, respectively. Despite this recent shift in growth rates, Columbia still contains over 50 percent of the population of the local impact area, but the trend in the 1970's should be closely analyzed as projections throughout the year 2000 are made.

While each of the three local impact counties experienced an increase in population during the 1960's, both Hamilton and Suwannee Counties had net out-migration.[1] Table 2.8-3 indicates that net migration in Hamilton County during the period 1960 to 1970 was -12.4 percent while the rate of migration in Suwannee County was -5.6 percent. Net migration in Columbia County was 11.2 percent during the period. The State of Florida as a whole experienced a 26.8 percent rate of net migration during the sixties. From 1970 to 1975 all three counties continued to increase in population, but in this period Hamilton and Suwannee Counties joined Columbia with net in-migration as illustrated in Table 2.8-4. Suwannee County experienced the highest net in-migration rate, equal to 17.5 percent, while Columbia and Hamilton's rates were 8.8 and 8.6, respectively. The entire impact area increased its population due to net migration by 5,503 people or 11.3 percent. During this same period, Florida increased its population due to migration by 22.7 percent. These data reaffirm the relative gains by Suwannee County during the 1970's. The population for the three-county area has been classified according to age, sex, and race in Table 2.8-5 as of 1976. This information may be significant when projecting the labor force, working-age population, and school enrollment.

2.8.2 EMPLOYMENT

In 1974, 3,174,600 Floridians were gainfully employed, out of a total civilian labor force of 3,520,000. The number of employed workers had increased by 30 percent since 1970, a 7 percent annual average, but the labor force had increased by 39.6 percent over this same period. Hence, the unemployment rate climbed from approximately 4 percent in 1970 to over 10 percent in 1974. The year 1974, of course, represents the first year of the 1974-75 recession which hit several states, including Florida, very hard. The employment characteristics of Florida and the local impact area are illustrated in Tables 2.8-6 for 1970 and Table 2.8-7 for 1974.

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[1] Migration is a measure of the rate at which people move into or out of an area. A change in population from one time period to another results from three components: births, deaths, and migration. After allowing for births and deaths during the period, the remainder of the change in population (which may be either negative or positive) represents migration. This number expressed as a percent of the original population is called the net migration rate.

Employment in the local impact area increased at approximately the same rate as did employment for the state. Within Hamilton County (where Occidental is located), however, the unemployment rate was only 4.4 percent. For the local impact area, the unemployment problem mirrored the state with the unemployment rising from 2.4 percent in 1970 to 9.1 percent in 1974. In 1974 in the three-county area, approximately 2,100 persons were jobless, though they were actively seeking work. The job picture in 1976 in these counties and the attributes of the unemployed workers must be documented before the impact of the proposed plant expansion by Occidental can be accurately assessed. The employment structure by industry for the state and the local impact area is given in Table 2.8-8. The most noticeable item is the large number of persons employed in services, mining, and miscellaneous in Hamilton County. This employment pattern is undoubtedly due to the presence of Occidental Chemical Company in Hamilton County. The three-county area also has a larger fraction of government employees than the state as a whole. Approximately 20.0 percent of Florida's nonagriculture employment is governmental employees, while in the local impact area over 30.0 percent of all nonagricultural employment is government employees.

2.8.2.1 Occidental's Employment in the Local Impact Area

Occidental's present plant facilities employ a large number of workers in the local impact area. Occidental's employment for 1974 through 1977 is given in Table 2.8-9. This information was taken from an annual survey submitted to the Florida Phosphate Council. As a first approximation, Occidental employs approximately 6 percent of all workers in the three-county area. This, of course, marks Occidental as a significant employer in the region and suggests that local employment opportunities are strongly affected by the status of Occidental Chemical Company.

2.8.2.2 Income and Earnings

A community's population provides the ingredient for the labor force and the productive efforts of the community, and the productive effort provides a community with its income and living standard. The income and earnings of the persons living and working in the three-county impact area are summarized below for the past 12 years.

Table 2.8-10 involves information on personal income by place of residence in Florida and the three-county region for 1970 and 1974. The income figures are in current dollars so they reflect both price changes and real increases in the purchasing power of the area's citizens. Florida's personal income increased by 71 percent from 1970 to 1974 representing a 14.4 percent annual increase, while the local impact area's personal income rose by 80.6 percent over this same time period or annually at a rate of approximately 16.0 percent. Hamilton County experienced a 20.6 percent growth rate per year from 1970 to 1974 to lead the three-county area by a substantial margin; Columbia and Suwannee Counties experienced a four-year growth of 70.4 and 80.9, respectively.

Income can be measured in terms of place of residence or in terms of place of work with the difference being due to any commuting between one's home and one's job. (See Table 2.8-11.) For example, income earned in Florida may be less than income earned by Floridians since residents of Georgia can and do work in Florida. Differences between states are not usually substantial, but differences among counties may be substantial since there is a greater likelihood of commuting among counties. A comparison of income by place of residence and income by place of work is presented in Table 2.8-12 for Florida and the local impact area.

These data show that the incomes of persons living in Columbia and Suwannee Counties are greater than the incomes earned in those counties. This is to be expected given the earlier information regarding the counties in which Occidental's employees live. That is, these two counties are, to some degree, "bedroom" counties for people working in Hamilton County, especially those working at Occidental.

Income can be further divided into earned income and total income with the difference representing income to retirees or persons living off government or other transfer payments. For a state like Florida with many retirees, this may be a significant difference, although it is not as significant in the study area counties as in other areas of Florida.

Earned income includes wages and salaries accruing to workers, profits accruing to business establishments, dividends accruing to corporate stockholders, plus rent on property, interest, and income to other factors of production. Total personal income, earned income, and wages and salaries for Florida and the local impact area for 1971 and 1974 are presented in Table 2.8-13.

In 1971, earned income represented 86 percent of personal income for the state, but for the local impact area earned income represented 89 percent of personal income. By 1974, earned income represented 70 percent of personal income for the state and 80 percent in the local impact area. This is one indication that Columbia, Hamilton, and Suwannee Counties have fewer retired persons than other parts of the state.

At this point, a few summary statements can be made. In terms of population growth, the local impact area has not kept pace with the rest of Florida, but in terms of per capita income, especially during the 1970's, the local impact area has done better than the rest of the state. Columbia and Suwannee Counties both suffered unemployment increases during 1974 similar to the whole State of Florida, but Hamilton County experienced a much smaller increment in unemployment.

2.8.3 HOUSING UNITS AND CHARACTERISTICS

As a result of the rapidly expanding population, the housing demand in Florida has increased significantly in the past decade. While population increased by 37.1 percent during the 1960's, the number of occupied housing units rose by 46.7 percent. This reflects, in part, the current trend toward fewer persons per housing unit. It probably also reflects, in part, the trend toward more second homes.

Tables 2.8-14 and 2.8-15 present selected housing characteristics for both Florida and the local impact area. In 1960, about 67.5 percent of Florida's occupied housing units were owner-occupied, while by 1970, 68.6 percent of the occupied housing units were owner-occupied; there is a growing trend toward increased home ownership in Florida. This trend is even more pronounced in the three-county area. In 1960, about 65 percent of the occupied units were owner-occupied while in 1970, ownership had grown to 72.7 percent.

In terms of houses available (for sale or rent), the local impact area had 466 in 1960 and 550 in 1970. Additional data beyond 1970 are not presently available, but any increase in the population due to Occidental's proposed expansion will have an impact on the local housing industry, including apartments and mobile homes.

2.8.4 PUBLIC EXPENDITURES AND STATE AND LOCAL TAX COLLECTIONS

Providing public services is, of course, the major responsibility of governmental units, but, by their very nature, public services do not automatically respond to normal market forces. Public services cannot be provided in a private market and many public services require a long-term investment. Hence, the decision to increase a public service must be made on the basis of permanent increases in population and income. Also, the tax collections from the incoming population and the associated increases in income should be sufficient to pay for the additional public services. What a community or region has in terms of public services and tax sources becomes a significant issue in analyzing the socioeconomic impact of a major expansion by a large firm.

2.8.4.1 State Tax Collections

Operating income for the state of Florida comes from a variety of sources including state taxes, intergovernmental transfers, and interest on investments, but, by far, most of the operating income comes from state tax collections. Between the fiscal years of 1966 and 1976, state tax collections accounted for approximately 70 percent of all operating income. Sales tax collections, in turn, make up the major part of state tax collections. Florida's operating income, the revenues from tax sources, and revenues from specific taxes are illustrated in Table 2.8-16.

The sales tax accounts for approximately 40 percent of all tax collections. This situation has been true since fiscal 1968-69 when the sales tax rate was increased on most taxable commodities from 3 to 4 percent. The sales tax is a tax which responds to the overall growth of the state's economy so it can be expected to grow with the economy.

The corporate income tax and severance tax on solid minerals are recently enacted taxes, with the corporate tax being enacted in 1971 to be effective in 1971 and the severance tax also being enacted in 1971.

The corporate income tax presently accounts for approximately 6 percent of state tax collections. The corporate tax rate is a flat 5 percent of net income earned in the state less a $5,000 exemption.

The severance tax on solid minerals accounted for less than 1 percent of total tax collections as of fiscal 1976. According to the Florida Department of Revenue, 98 percent of the severance tax collections are related to phosphate mining. The tax rate is 5 percent of the value of solid minerals at the point of severance. The value of the mineral is determined by eliminating post severance production costs from delivery prices. A phosphate company can credit up to 20 percent of local ad valorem taxes against this tax and a company may receive refunds of up to one-half of the taxes paid for approved reclamation projects.

These taxes have been keynoted since Occidental's planned expansion will directly affect the revenues generated through them. Occidental paid the following sales taxes from 1972 through 1976:

1972	$ 350,000
1973	425,000
1974	684,000
1975	2,473,000
1976	1,687,000

Occidental's severance tax payments, credits, and refunds are illustrated in Table 2.8-17 for 1974-1976. Corporate taxes paid by Occidental are not available.

State taxes paid by the citizens and companies of individual counties are not available. State tax collections by planning district are, however, available. Columbia, Hamilton, and Suwannee Counties are in Planning District 3 along with Alachua, Bradford, Dixie, Gilchrist, Lafayette, Madison, Taylor, and Union Counties. Alachua County, with Gainesville as its largest city, is the population center of this planning district. In fiscal 1975-76, District 3 accounted for $31.4 million in state sales taxes and in fiscal 1976-77, this district accounted for $34.6 million in state sales taxes. The local impact area accounted for approximately 22 percent of this district's population during this period. As a rough approximation then, the local impact area accounted for about $6.9 million in sales taxes in fiscal 1976 and $7.6 million in fiscal 1977.

2.8.4.2 Local Public Expenditures and Tax Collections

Local public expenditures and local tax collections by county for fiscal 1974-1976 are presented in Tables 2.8-18 and 19. These totals include county governments, and city governments located within the impact area counties. These local expenditures include general government operations, public safety, transportation, and other typical local governmental services, but they exclude educational expenditures since education will be dealt with separately. Utility services provided through city-owned utility companies are included in both the expenditures and revenue collections. These data do not suggest that there are any unusual public services provided by any of the three counties.

Per capita public expenditures for selected public services are presented in Table 2.8-20. General government appears to be more expensive in Hamilton County than in Columbia or Suwannee.

Transportation expenditures per capita are higher in Hamilton than the surrounding counties by a substantial margin--$115.38 in Hamilton relative to $56.50 in Columbia and $59.69 in Suwannee. This comparison may emphasize an age-old problem in public finance. That is, many persons live in Columbia or Suwannee, but work in Hamilton County. This phenomenon was previously documented when Occidental's employment patterns were discussed. The question then becomes, "Who pays for the network of roads?" Is it the state, through intergovernmental transfers, the persons who use the road, their employers, or the taxpayers in Hamilton County?

Per capita property tax collections for the local impact area are illustrated in Table 2.8-21. On a per capita basis citizens of Hamilton and Suwannee counties pay substantially more than the citizens of Columbia County. The data for Hamilton County, however, must be interpreted very carefully since Occidental pays property taxes there. The property taxes paid by Occidental cannot be counted as a burden on Hamilton's citizens. In fact, property taxes paid by Occidental on a calendar year basis in Hamilton County for 1974, 1975, and 1976 are as follows:

1974	$223,916
1975	301,340
1976	627,471

Property taxes paid by Occidental do, of course, reduce substantially the tax burden of the citizen of Hamilton. Indeed, Occidental's property tax payments account for close to 25 percent of all property tax collections in Hamilton County. No meaningful comparison can be made with other counties, however, since information on the amount of property taxes paid by companies in these counties is not available.

In each county, property taxes rank as the second largest source of revenue, second only to intergovernmental transfers, if utility revenues and nonrevenue sources such as bond-sales are excluded. Property tax collections are the major source of revenue raised at the local level in Florida. Property tax collections are related to the assessed value of taxable property, the taxable value of this property, and the millage rate. Table 2.8-22 contains this information for Columbia, Hamilton, and Suwannee Counties for 1974-1976.

Assessed value is defined by law as the annual determination of the just or fair market value of property for tax purposes as defined in the Florida Statutes. The terms assessed value and appraised value are used interchangeably. Taxable value is defined as the value against which taxes are levied. This value is derived by subtracting from the assessed value all applicable exemptions, differentials, and immunities.

There is no available published information on the fraction of assessed or taxable values that belong to business, as opposed to homeowners. Most of the exemptions and immunities refer to homeowners or government owned land, or land belonging to nonprofit institutions. There is an inventory differential that refers to business establishments.

2.8.5 EDUCATION: ENROLLMENT AND EXPENDITURES

Certainly one of the most significant functions of local governments is to provide elementary and secondary education. Hence, one of the potential effects on a community if a firm expands is to impact school enrollment and school expenditures.

School enrollment in the three-county area and in Florida as of September, 1975 is listed in Table 2.8-23 by grades. School enrollment in the three-county area deviates slightly from the school enrollment pattern in the entire state. Approximately 29 percent of school children across the state are in kindergarten or the first three grades, while in the three-county area over 30 percent of all school children are in the same grades. Relatively speaking, fewer school children are in the 11th and 12th grades in the three-county area than is true throughout the state.

The University of Florida has projected school enrollment through 1980 by county, given no major change in economic conditions. These projections are included in Table 2.8-24.

The revenues to support these schools are reported in Table 2.8-25 and the expenses associated with the schools are reported in Table 2.8-26. The most noticeable aspect of school revenues is that the local impact area gets over 65 percent of their school revenues from the state and only about 20 percent of their school revenues from local sources. On the average across the state, only about 55 percent of the school revenues are from state sources and over 35 percent of school revenues are derived from local sources. In terms of school expenses Columbia embarked on a large capital improvement project in the 1974-75 academic year, while Hamilton and Suwannee allowed for only very modest capital improvements.

2.8.6 SUMMARY FOR LOCAL IMPACT AREA

The local impact area has been described in terms of population, employment, income, governmental revenues and services, and educational enrollment and expenditures. The population appears to be growing more slowly than Florida's population, though growth in the local impact area during the 1970's has exceeded the area's growth during the 1960's. Income and employment in the local impact area has grown more rapidly than Florida's overall economic growth, especially during the 1970's. Hamilton County, in particular, has experienced employment and income growth which was related, at least in part, to Occidental's expansion in the early 1970's. Public services and public revenues in the local impact area do not appear to be very different from practices throughout the State of Florida.

Revenues for education is the one exception. The local impact area receives proportionately more state money and uses less local money for elementary and secondary education than other areas of the state. School enrollment in the local impact area also appears to be slightly younger than the average throughout the state. This, of course, has implications for future school enrollment and also suggests something about the age distribution of the population in the local impact area.

2.8.7 LOCAL LAND USE LAWS, ORDINANCES AND REGULATIONS

Effectively, neither of the three counties affected most directly by Occidental's planned expansion presently have any local land use ordinances or regulations. The City of Lake City does have a zoning ordinance but zoning there is not seen as either affecting or being affected by Occidental's planned expansion.

Neither do any of the local goverments in the three counties, at this time, have any officially approved land use plans, although all three have had preliminary land use studies done by Barr, Dunlop & Associates, Inc., a consulting firm from Tallahassee, Florida. The Local Government Comprehensive Planning Act of 1975 provides that all local goverments are to complete and adopt comprehensive land use plans not later than July 1, 1979. All of the local governments in the three-county area are currently working with the North Central Florida Regional Planning Council in Gainesville to this end.

None of the comprehensive plans have been completed as of this date. The staff of the North Central Florida Regional Planning Council has been contacted in person twice during the conduct of this study, and the conformity of Occidental's Hamilton County plant expansions to plans which are likely to result has been discussed. There does not appear to be any disagreement at this point as to the likely maximum impact of the planned expansion on land use in the area. It appears certain that the expansion will be in full conformity with plans that will ultimately be adopted.

2.8.7.1 Land Use in the Local Impact Area

A region's land and the associated natural characteristics of that land are the beginnings of a region's economic and environmental success. The land offers the potential for persons to earn a decent living and for persons to live a gratifying life. Any major alteration in the existing land uses should be analyzed with respect to the private costs and benefits and the social costs and benefits, and special attention should be made to repercussions throughout the region from this alteration. The case at hand is Occidental's proposed expansion in phosphate mining and phosphate processing in Hamilton County. This expansion, however, may affect the population thereby affecting residential construction in the area as well as public and private establishments needed to serve the larger plant and the larger population. Some land now being used for agricultural purposes or for forest land may perhaps need to be converted to other use.

The existing land use in Columbia, Hamilton, and Suwannee Counties will be described in detail. One final caveat should be stated. To find that so many acres are now agricultural land does not mean that they should always be agricultural land. Their value in a different use may at some point exceed their value as agricultural land. The major point of a land use study is to allow for an orderly transition if a change in land use is called for and to take into account any costs or benefits that a private entity would not typically take into account.

2.8.7.2 Land Use Studies

In 1975 the State of Florida passed the local Government Comprehensive Planning Act which requires the adoption of a comprehensive land use plan by all counties, municipalities, and special districts in the state. Each county and/or municipality must prepare a land use plan and have a planning commission. The county and each municipality may have separate commissions or there may be a joint commission. The existing land use as described in this report is based on preliminary studies to this end. Projected land use will be based on population, income, employment, and public service projections provided in this economic impact study. None of the land use plans under this law have been completed and approved in any of the counties.

2.8.7.3 Hamilton County

The three major land uses found in Hamilton County are agricultural, forestry, and mining. This can easily be seen in Figure 2.8-1, a generalized land use map of Hamilton County, along with Columbia and Suwannee Counties. Agricultural land is concentrated in the western part of the county, though some agricultural land is scattered throughout the county. Mining activities are to the north of White Springs in the eastern part of the county. Forest land can be found throughout Hamilton County.

There are 512 square miles in Hamilton, and 21 percent of this area is devoted to agricultural uses, 72 percent for forest uses or forest-related uses, and 3 percent for extractive purposes. This means 4 percent of the land is left for residential purposes, transportation systems, industrial and commercial establishments, and other such uses. The various uses of the land are tabulated in Table 2.8-27. Land uses within the incorporated area of Jasper, Jennings, and White Springs are presented in Table 2.8-28.

Hamilton County is a rural county without any serious land use conflicts at this time. The county is sparsely populated with 15.0 persons per square mile in 1970 compared to 125.4 persons per square mile for the entire state, and 24.7 persons per square mile for the neighboring counties of Madison, Suwannee, and Columbia. The town of Jasper is the only place in Hamilton County with concentrations of people. There are several developments around Jasper in which more than 45 dwelling units per square mile exist.

Apparently, any population increases will not adversely affect the living conditions of others in terms of space requirements or will not cause valuable agricultural or forest land to be converted to residential use.

Finally, it should be noted that mining for phosphate will temporarily transfer land from forest to extractive purposes. Private firms are making the transaction so it can be reasonably assured that the land being mined is more valuable than the land being used for timber. The land will not necessarily be permanently lost for timber production since the land can be reclaimed, and indeed must be, under present Florida law.

2.8.7.4 Suwannee County

Suwannee County has approximately 435,000 acres, exclusive of the town of Live Oak. Live Oak represents another 3,000 acres so in total Suwannee County is composed of over 438,000 acres. Much of this land is agricultural acres and private and corporate woodlands. As of now, little land is used for mining purposes even though limestone is abundant in the area. The general land use in Suwannee County is represented in Figure 2.8-1, along with that in Hamilton and Columbia Counties.

Land use in Suwannee County is illustrated further in Table 2.8-29. The figure and the table do not include information about Live Oak since

Live Oak is completing a separate comprehensive plan. Apparently the rationale is that Live Oak is sufficiently different from the rest of the county to justify a separate comprehensive plan.

The categories used in Table 2.8-29 can be more specifically defined as follows:

Residential, includes single and multi-dwellings, and mobile homes.
Commercial, includes retail sales, etc.
Industrial, includes manufacturing and warehouses, etc.
Institutional, includes churches, schools, etc.
Recreation, includes parks, plus other facilities.
Agricultural, includes crop land and grazing land.
Forests and Natural areas, includes forests and land not otherwise defined.

Table 2.8-29 clearly suggests that Suwannee County is a rural area without any major concentration of people, industries, or commercial establishments. Over 97 percent of the county is used for agricultural purposes or for forest or forest-related purposes. The 18,000 persons who live in Suwannee County live in the other 3 percent of the rural area plus Live Oak.

2.8.7.5 Columbia County

In Columbia County there are 504,844 acres. As depicted in Figure 2.8-1, forest and agriculture are the predominant uses of the land.

Forests represent 69.7 percent of the county. Included in this forest area are planted forest (35.2 percent of total land), mixed forested acres (15.7 percent), and the Osceola National Forest (15.4 percent). Also included in the 69.7 percent is 3.4 percent consisting of the county's land that is vegetated/nonforested wetlands, clear-cut or water uses. The forest land is concentrated in the northern section with some forest throughout Columbia County. The Osceola National Forest is located in the east central part of Columbia County, just northeast of Lake City.

Agricultural land is concentrated in the south and west central areas of Columbia County. Twenty-six percent of all land in the county is used for agricultural purposes. When agriculture and forest are combined nearly 96 percent of all available land is included.

The remaining 4 percent of Columbia County's land is distributed between residential, commercial, industrial, transportation, and other purposes. Table 2.8-30 gives all land uses in Columbia County with their corresponding percentages.

The land use in the incorporated areas is significantly different from that of the unincorporated areas. Precise data for Lake City are not presently available but the land uses there are more urban in nature than the rural characteristics of the entire county. Readily apparent, for example, is the 3.6 percent used for residential purposes in Fort White versus 1.1 percent for the entire unincorporated part of the county (Table 2.8-31).

There are few land use conflicts existing in the rural areas of Columbia County. Most of this land is either used for forest or agriculture and there are no major industrial facilities located in the rural areas. In the urban areas surrounding Lake City there is minor conflict between agricultural land and the expansion of residential development and industrial growth. Also, there is some conflict of land use near the Lake City airport with residential development along the approach corridor to the airport. There are some surrounding areas of Lake City that are mixed with residential and industrial land uses, but there has been little or not conflict in their coexistance.

Within Columbia County there exists a possibility for conflict in the northern area betwen forest land and the mining of phosphate. Any transfer of land use from forest to mining would be done after careful consideration of the environmental and economic effects of such a transfer. Assuming that proper reclamation procedures are followed as required, this land, if transferred from forest to mining, would then be used again to produce timber.

2.8.8 TRANSPORTATION SYSTEM

The three counties which will be most affected by the proposed Occidental expansion (Columbia, Hamilton, and Suwannee) are served well by highway systems. The east-west interstate highway (I-10) is intersected a few miles to the northwest of Lake City by the major north-south route (I-75). In addition, the three counties are served by U.S. Highways 41, 441, 90 and 129, as well as state highways 6, 10, 51, 249, 49, 795, 100, 137, 25, 134, 135, 47, 136, 250, 252, 242, 245, and 16, and numerous miles of streets and lesser roads.

The area has adequate rail service and is served by a general aviation airport at Lake City. A map indicating the major highway network is shown in Figure 2.8-2.

2.8.9 HISTORICAL TRENDS OF SOCIOECONOMIC VARIABLES FOR DUVAL COUNTY

Duval County is being dealt with separately from Columbia, Hamilton, and Suwannee Counties since the impact of Occidental's planned expansion of processing and transporting phosphates will surely have a different impact on Duval County than on the other local impact area. The mines and the processing plant are located in Hamilton County, and many of Occidental's employees live in neighboring Columbia and Suwannee Counties so that construction of the new plant and the increase in plant activity will have temporary and permanent effects in this three-county area. Duval County will be affected moderately because Occidental plans to transport the processed phosphates to Jacksonville, Florida by rail and then to ship the processed phosphates to the Soviet Union in exchange for ammonia, urea and potash. Hence, the port facilities in Jacksonville will experience an increase in traffic due to Occidental's proposed trade with the Soviet Union. It should be noted only the SPA will be shipped through the port of Jacksonville. The ammonia, urea and potash will be handled through other ports.

2.8.10 POPULATION, EMPLOYMENT, AND INCOME

Duval County as of mid-1976 had 579,700 residents. This represents an increase of over 120,000 persons since 1960: a 27.3 percent increase in seventeen years. Duval's population growth is illustrated in Table 2.8-32.

The employment pattern in Duval County (represented by the Jacksonville SMSA) is presented in Table 2.8-33 along with the employment pattern for Florida. The Jacksonville SMSA represents around 9 percent of total Florida nonagricultural employment and the breakdown of its employment according to industry is very close to exactly the breakdown across the state. The Jacksonville SMSA has, relatively speaking, more persons employed in finance, insurance, and real estate, and transportation and communications, and fewer persons employed in services, mining, and miscellaneous than the state as a whole. But the differences are slight so no major insights can be drawn from them.

In March 1975, the unemployment rate in the Jacksonville SMSA was substantially less than the unemployment rate for the entire state, 6.5 percent as compared to 10.2 percent. The employment and unemployment data do not suggest any reason for this large difference. A possible explanation is that the Jacksonville area does not rely as much on tourist trade as do other Florida areas so the Jacksonville unemployment rose only because of secondary and tertiary effects of the general weakness in the national economy.

Occidental's presence in Duval County is relatively minor when measured in terms of employment and progress. As of September 1977, there were twelve employees of Occidental who lived in the Jacksonville area. Other persons, of course, may be employed there because of Occidental's presence in Northern Florida, but such estimates cannot be made at this time.

Total personal income and per capita income by place of work are given for Duval County and Florida in Table 2.8-34. Income by place of residence will be slightly lower for Duval County since many persons may work in the Jacksonville area but live in rural areas. In 1974, per capita income by place of residence was $5,416 in Duval County while by place of work it was $5,322. Both of these numbers were taken from the Florida Statistical Abstract, 1976.

2.8.11 TAXES, PUBLIC SERVICES AND EDUCATION

Even though Duval County is much more populous than Columbia, Hamilton and Suwannee Counties, the tax and public expenditures structure is somewhat similar. Duval depends on the property tax and intergovernmental transfer to pay for public safety, transportation, recreation, and other public services. The major difference is probably that more economic assistance is available in Duval than in the three-county area. The revenues and expenditures of all governmental bodies in Duval County for fiscal 1975-76 with the exception of school districts and publicly owned utilities are presented in Table 2.8-35.

The major public service left out of Table 2.8-35 is public education. As of September 1975, there were 97,123 students enrolled in public schools in Duval County with 29,585 in kindergarten through the third grade, 57,535 in grades four through ten, and 10,003 in grades eleven and twelve.

Duval County spent over $137 million to support elementary and secondary education in school year 1974-75 with 2.8 percent coming from federal sources, 69.0 percent from the state and the remainder from local tax and revenue sources. Public expenditures in school year 1974-75 ran to over $1,400.00 per student in Duval County.

2.8.12 JACKSONVILLE PORT FACILITIES

The proposed Occidental phosphate project involves mining phosphate in North Central Florida, converting the phosphate rock to superphosphoric acid (SPA), transporting the SPA to Jacksonville by rail, and, finally, shipping the SPA to the Soviet Union. In return, Occidental will receive ammonia, urea, and potash from the Soviet Union, but these commodities are not expected to be shipped through the port of Jacksonville. At this time, Occidental plans to ship 480,000 metric tons of SPA in 1979 and one million metric tons of SPA per year to 1997.

The Jacksonville Harbor is presently the second most heavily used harbor in Florida with the Tampa Harbor handling almost three times or much tonnage as Jacksonville. In 1974, Tampa handled 40.9 million short tons while Jacksonville Harbor handled 14.8 short tons. Jacksonville is the largest port in Florida along the Atlantic coast in terms of tonnage handled with Port Everglades being second in size with 11.6 million short tons in 1974.

In 1972 the value of exports going through Jacksonville was $74 million and the value of imports was $619 million. The total value of exports and imports equal $693 million. Miami Harbor ranks second to the Jacksonville port along the Atlantic coast in terms of total value of exports and imports. In 1972, the combined value of exports and imports going through Miami was $671 million. Tampa Harbor, which is easily the largest port in Florida in terms of tonnage, handled only $485 million in terms of value.

In 1972, in Duval County there were 2,837 employees associated with water transportation according to the Bureau of Census in its publication, County Business Patterns. In the state, there were 9,697 employees associated with water transportation. Thus, Jacksonville accounts for around 29 percent of all employees working in water transportation. In terms of value of exports and imports, Jacksonville also accounts for around 29 percent of exports and imports going through Florida ports. In terms of tonnage, the Jacksonville port accounted for around 16 percent of all trade being carried out through the Florida ports.

The Jacksonville Harbor can be conveniently summarized as follows: A very large port in terms of tonnage of shipments and in terms of value of exports and imports relative to other ports and harbors in Florida, a port that employs a high percentage of all water transportation workers in the state of Florida; and a port that is busier trading with imports than it is with exports. The Occidental project implies an increase in its export trade.

2.8.13 SUMMARY

In terms of population, employment, income, tax collections and public services, the Occidental proposed project will have, at most, a minor impact on the Jacksonville area. In fact, the Occidental impact will hardly be perceptible on aggregate data for the Jacksonville SMSA.

2.8.14 BASELINE PROJECTIONS FOR THE LOCAL IMPACT AREA

2.8.14.1 Introduction

In Section 2.8.1 of this study, the historical trends of major socioeconomic variables were examined for the state of Florida, the three-county area most immediately affected by Occidental's plan (Columbia, Hamilton, and Suwannee), and Duval County in which the Jacksonville port is located. Population, employment, income, public service, public revenues and land use were examined through the latest available data. These data provide the groundwork for all projections. This section contains baseline projections for the major socioeconomic variables assuming that Occidental does not expand its mining and plant facilities.

This section contains baseline projections for the State of Florida and the three-county area. Projections are provided for population, employment, income, public services, public funds and land use. Baseline projections are constructed on the assumption that the social and economic characteristics of the area do not undergo a radical change in the years ahead, that no major changes in the law occur which might affect the economic development of the region, and that the past development of the area accurately suggests what can be anticipated about the future.

Baseline projections through the year 2000 are provided in this study. There is no sophisticated model or technique that will generate exact numerical projections for the year 2000 for all of the previously mentioned socioeconomic variables. Numerical projections are required, however, to overcome the vagueness of such phrases as "moderate growth," "substantial growth," or some similar description. The numerical projections are reasonable approximations of the magnitude of these variables in the future.

Baseline projections are based on what has happened in the past, but these past relationships can be altered if there is clear evidence that they will not continue into the future. Hence, baseline projections are more than a simple extrapolation of the past, though an analysis of what has happened is important in suggesting what might happen in the future. Baseline projections are then reasonable estimates of what the population will be, what employment and income will be, what public services and public revenues will be, and what changes in the use of the finite supply of land will take place over the next quarter of a century. These estimates can be used by public officials, industrial leaders, or other concerned groups interested in planning for the future.

The study will first present the population projections; second, employment and income projections; third, public services and public revenue projections; and, finally, projections concerning land use. State projections are made for population, employment, income, and selected state taxes; local impact area projections are made for population, employment, income, housing, public services, local tax receipts, and land use within the three-county area.

2.8.14.2 Baseline Population Projections

The population projections are based on the University of Florida's estimates--projections that are annually updated by the Bureau of Economic and Business Research of the University of Florida. Other long-term population studies such as the OBERS projections[1] have recently been revised to match the University of Florida projections.[2]

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[1] OBERS projections were commissioned by the U.S. Water Resources Council, 1972.

[2] A recent study published by the Corps of Engineers, but prepared by the Bureau of Economic Analysis of the Department of Commerce, Projections of Economic Activity, accepted the long-term population projections of the University of Florida by revising upwards the OBERS projections. A draft of this study appeared in 1975. In contrast, a 1974 study prepared by the Regional Economic Analysis Division of the Bureau of Economic Analysis, "State Projections of Income, Employment, and Population to 1990", made use of projections similar to the OBERS projections.

Alternative population projections for the State of Florida are given in Table 2.8-36, including the University of Florida's estimates, the OBERS projections, and projections completed by the U.S. Department of Commerce. In Table 2.8-37 population projections for Columbia, Hamilton and Suwannee Counties are presented. These projections include underlying assumptions about the birth rate, the movement of persons within the United States, changes in the age distribution of the population, industrial and employment shifts within the United States, and other influences that are significant in determining a state's population and the population of individual counties.

The University of Florida's estimates are significantly higher than the OBERS projections or the estimates by the Department of Commerce. The OBERS projections were published in 1972, the Department of Commerce projections in 1974, and the University of Florida estimates in 1976. The revised estimates for 1975 prepared by the University of Florida exceed the 1980 OBERS projections and make the 1980 projections of the Department of Commerce appear to be unrealistically low. The OBERS projections assume an annual growth rate of 1.8 percent from 1970 to 1980; 1.9 percent from 1980 to 1990; and 1.7 percent for the last ten years of this century. The Department of Commerce assumes a 2.7 percent annual growth rate from 1970 to 1980 and a 2.1 percent growth rate from 1980 to 1990. From 1970 to 1980, the University of Florida estimates suggest a 3.7 percent yearly compounded growth rate; during the 1980's, a 2.3 percent growth rate; and during the 1990's, a 1.6 percent growth rate.

The University of Florida estimates appear to be the most reliable projections on several counts. First, from 1970 to 1975, Florida's population grew at an annual rate of 4.4 percent from 1970 to 1975 based on the updated 1975 population estimates prepared by the University of Florida. Second, the higher growth rates for Florida in the 1970's seem to be supported by the continuing migration of persons and firms from the northeast to the southeast and southwest. Third, the number of persons moving into retirement ages in the United States suggests that Florida will probably grow more rapidly than the rest of the country. Finally, the age distribution of the U.S. population and the postponement of having children by women in their childbearing years suggests that overall population growth will be greater in the 1980's than in the 1990's.

The local impact area is not expected to grow as rapidly as the State based on the historical growth of the region relative to the historical growth of the State. In 1960, the local impact area represented 0.9 percent of the State's population, but in 1970 it represented only 0.7 percent of the State's population. By the year 2000, assuming no major industrial changes, the local impact area is predicted to represent only 0.5 percent of the State's population.

The three-county region will not attract retired persons and it will not grow in population because of the growth of surrounding counties. The local impact area will grow because of the growth of local industries and any substantial growth will be related to unexpected and/or expected unusually large industrial growth.

The population does not change independently of income differentials and employment opportunities, but the population estimates are supportable within the economic environment in the local impact area. The growth in employment and income necessary to support the large population will be discussed in the next section.

2.8.15 BASELINE PROJECTIONS OF EMPLOYMENT AND INCOME

This section provides long-term projections for employment and income in Florida and in the three-county area. These projections are based on previous economic growth in the county, in Florida and in the local impact area.

2.8.15.1 Employment

Persons will stay in Florida and in the local impact area or will move to Florida and the local impact area if employment opportunities are available. The employment projections that follow are compatible with the population estimates previously documented and the employment projections are compatible with what can reasonably be expected in terms of industrial growth.

In 1970, according to the U.S. Census, approximately 37 percent of the total population[3] in Florida and in Columbia and Suwannee Counties were active members of the civilian labor force, either working or actively seeking work. In Hamilton County, approximately 33 percent of the total population made up the civilian labor force. By 1975 for the State of Florida, approximately 41 percent of the total population were in the labor force, a rather substantial increase over the five-year period. Comparable ratios for the counties cannot be calculated for 1975 since workers by place of residence are collected only by the Census.[4] The large increase in persons participating in the labor force, of course, corresponds to the change in the age distribution of the population and to the increased participation by women in the work force.

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[3] Typically, the labor force participation rate refers to the persons in the labor force relative to the working age population, but the breakdown of the population by age was not available, so the participation rate is defined in terms of the total population.

There are no reasons to suggest that the fraction of the population working or seeking work will decline. Women have apparently changed permanently their attitudes about careers; the mandatory retirement age is being raised and may be abolished; and, many families are growing accustomed to the income earned by both the husband and wife. For the state of Florida and the counties of Columbia and Hamilton, it was assumed that 41 percent of the population would be members of the civilian labor force. It was assumed that 35 percent of the population in Hamilton County would be part of the labor force. The lower percentage in Hamilton County represents the historical difference between Hamilton and other parts of the State and the fact that there are probably fewer employment opportunities for women in Hamilton County than in other parts of the state. In Table 2.8-3, projected civilian labor force for the State and the three-county area is given through the year 2000.

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[4] Employment data compiled by the Florida Department of Commerce are based on place of work, not place of residence. State data by place of residence or place of work are roughly comparable; county data by place of residency or place of work will not be comparable.

The civilian labor force should be relatively stable and without volatile swings since the labor force is determined by the population, the age distribution of the population, and the labor force participation rate. Only the labor force participation rate is subject to cyclical fluctuations. Employment, on the other hand, is subject to cyclical fluctuations because of national and state economic conditions, as well as random fluctuations because of labor conditions or other such one-shot phenomena.

Employment is projected on the basis of a fully employed labor force, which means that approximately 95 percent of those in the labor force will be employed.[5] The 95 percent rule is a national rule of thumb, but no such rule exists for a state or for a region within a state because of long-term or cyclical differences among the states and regions. The employment projections are presented in Table 2.8-39.

Employment by industry can be projected on the assumption that industrial employment patterns that existed in the 1970s continue to exist during the 1980's and 1990's. There is no reason to postulate a radical change in industrial employment patterns since there is no evidence to suggest such a radical change. The economic growth in the area should be relatively balanced throughout the various industries.

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[5] Economists differ on the precise rate of employment that constitutes full employment, but according to the Economic Report of the President, 1976, the unemployment rate associated with a full-employment economy was set at 4.9 percent.

The breakdown of employment by industry is given in Tables 2.8-40 through 2.8-42 for Columbia, Hamilton, and Suwannee Counties. The industrial breakdown of employment includes those employees that are covered by unemployment insurance and other workers tabulated by the Division of Employment Security; hence the total employment in these counties will be greater than that indicated by the industrial breakdown. In 1975, approximately 80 percent of all employees were covered by unemployment insurance. This will change because of recent changes in the unemployment insurance laws, but all projections were based on laws existing in 1975. Total employment will not change because of the revised laws, but the industrial breakdown may. Finally, the industrial breakdown of employment is based on place of work, not place of residence.

2.8.15.2 Income

Income will rise because employment is rising, but income will also rise because of increased productivity and inflation. Since the rate of inflation is relatively volatile and is influenced heavily by international and national political decisions, there is no reliable way to forecast inflation rates over two decades. Thus, all income magnitudes will be stated here in real terms--that is, adjusted for all price increases. Real income per capita is, of course, the most important measure of the average standard of living of a community, region, or state.

The past growth in real per capita income for Florida and the local impact area will first be reviewed and their projections made on the basis of the anticipated employment trends and the anticipated productivity trends. In Table 2.8-43, the growth in real per capita income for Florida and the local impact area and the standing of the local impact area relative to the State are presented.

The local impact area showed a greater annual growth in real per capita income from 1970 to 1974 than the State as a whole. The year 1974, of course, represents the first year of the 1974-75 recession and apparently the state suffered more in terms of foregone income than the local impact area. Also, Occidental Chemical Company was expanding its facilities during this time and this would certainly help offset a downturn in other segments of the economy of the local impact area. From 1965 to 1970, Columbia and Suwannee Counties grew at about the same rate as the state, but real per capita income in Hamilton County actually declined. From 1970 to 1974, real income in Hamilton grew at a substantial rate primarily because of the mining and plant operations of Occidental.

The real per capita income projections are presented in Table 2.8-44. These projections are based on an expected increase in productivity for Florida of approximately 2.5 percent through 1980 and 3.0 percent thereafter. This estimate is lower than the productivity rate of the 1960's for Florida, but higher than the productivity rate of the early 1970's. These productivity rates are based on the U.S. productivity rates as calculated by the Council of Economic Advisers.[6] From 1966 to 1973 productivity growth in the private sector of the U.S. economy was just over 2 percent; in Florida productivity growth for the entire economy from 1965 to 1974 was just over 4 percent. Florida had the room to grow in this period and it still has room to grow relative to other regions of the country, but it would be unnecessarily optimistic to believe that Florida can continue to double the productivity growth of the entire country. As the nation and Florida slowly work their way out of the mid-1970's recession, the suggested productivity increase is 2.5 percent; once the economy has reached and continues along its path of potential output, the suggested productivity increase is 3.0 percent.

Per capita real income in Columbia and Suwannee counties was projected to be 80 percent of the state's income throughout the period, continuing the relationship of the late 1960's and early 1970's. Per capita real income in Hamilton County was projected to be 85 percent of the State's income in 1980 and then gradually decline to 80 percent of the State's income by 1985 and continue at that level through the year 2000.

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[6] Economic Report of the President (United States Government Printing Office, 1977), pp. 45-46.

Total personal income for the state and for the local impact area was projected by taking account of the population projections and the productivity trends. These projections are listed in Table 2.8-45 in 1974 dollars. The personal income projections are especially important in computing projected tax receipts by the state government.

2.8.16 BASELINE PROJECTIONS OF HOUSING NEEDS

As employment opportunities grow, as population expands, and as income rises, housing requirements also expand. New employment opportunities and rising population suggest the need for more housing units to be built, while rising income may suggest a demand for better homes or for upgrading of existing homes. Other variables such as the changing family size will also influence the housing units that are required.

In Table 2.8-46, the number of persons per housing unit is presented for 1960 and 1970 for Florida and the local impact area. The persons per housing unit has declined rather substantially from 1960 to 1970 and, in particular, persons per housing unit has declined even more substantially in the local impact area.

It is projected that the persons per household will continue to decline through 1980 for the state and the local impact area and then to rise modestly through the next two decades. This projection is based on the age distribution of the population and the current shift of much of the population into the ages of 20 to 34, or those ages in which family formation is greatest. As the size of the families grow because of children, then the persons per household will rise, but not back to the 1960 levels since family size is now and is projected to be smaller than in previous years. The projected persons per housing unit and the projected required housing units are presented in Table 2.8-47. In the local impact area the largest increment in housing units will come during the 1970's and then there will be more modest increases in the 1980's and 1990's. The more modest increases in the 1980's and 1990's will be due to the gradually increasing family size.

2.8.17 BASELINE PROJECTIONS FOR PUBLIC SERVICES AND PUBLIC REVENUES

Baseline projections are constructed on the assumption that no major structural changes occur in the economy of the region being studied. New businesses may emerge and several firms will fail, but basically the economy grows because of the natural forces of population growth within the region, population growth from net migration to an area, and productivity increases.

The rising income will naturally result in increased tax collections, given no major changes in the tax codes. In this section additional state and local revenues consistent with the higher employment and income will be suggested and the growth in local public services required to maintain the current per capita public services will also be projected.

2.8.17.1 State Tax Collections

State taxes, at least some of the taxes, respond to economic growth in real terms and to inflation. As indicated in the historical review of the Florida economy, Florida relies most heavily on the sales tax as a source of revenue and to a smaller extent on the corporate income tax. These two taxes respond to real economic growth and to inflation. The real growth of the Florida economy has been projected through the year 2000, but inflation cannot be predicted reliably so tax collections are projected in terms of 1974 dollars.

Sales tax collections tend to grow proportionately with the growth in income. In other words, the elasticity of sales tax collections vis-a-vis income approximates unity. Sales tax collections are projected on this assumption; i.e., they are projected to grow at the same rate as real personal income. Corporate income taxes have been a fairly steady proportion of sales tax collections during the 1970's--15 percent to be precise. There is no legal reason for this steady relationship, but ultimately the same variables that influence sales tax collections also influence corporate income tax collections.

Hence, projections of the corporate income tax collections will be based on this steady relationship with the sales tax collections.[7] These projections are listed in Table 2.8-48.

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[7] This is similar to saying that the elasticity of corporate taxes with respect to income is unity and this elasticity should be very close to one since the corporate income tax is proportional in its impact on companies

No reliable baseline projections for the severance tax on solid minerals can be made at this time.

2.8.17.2 Local Expenditures and Revenues

All projected expenditures and revenues are stated in 1974 dollars because of the difficulty in projecting long-term inflation rates. If both expenditures and receipts are similarly affected by inflation, then the constant dollar projections will be entirely adequate. However, at the local level, tax collections (the property tax, in particular), are not as sensitive to inflation as local public expenditures. Local governments have to change the millage rate since the taxable value of property is not updated annually to keep pace with inflation. In addition, a large proportion of local revenues come from intergovernmental transfers and these payments are difficult to project for long periods of time. Public services will first be projected for Columbia, Hamilton and Suwannee, and then the necessary receipts will be assumed to be available. The question centers around the source of the receipts--either the property tax or intergovernmental transfers.

2.8.17.3 Local Public Services

Projected public services for Columbia, Hamilton and Suwannee Counties are presented in Tables 2.8-49, 50 and 51. These projections are constructed on the basis of public expenditures per capita during 1974, since expenditures per head for 1975 and 1976 were similar after adjusting for inflation. These public services include general government, public safety, transportation, recreation, environmental action, economic assistance and public health. Public expenditures on education will be dealt with separately. The public expenditures per head during the mid-1970's may not be optimal, but this is apparently what the voters in the local impact region have decided on collectively. The projections represent real increases in the level of public services, not merely dollar increases.

2.8.17.4 Public Revenues

To pay for the local public services local governments have to collect local taxes, charge fees for services rendered, or seek assistance from state and federal agencies. In the 1970's, as shown in Section 2.8.4, Columbia and Hamilton Counties had their property tax collections account for approximately 25 percent of their revenue, excluding utility fees and the school districts, while Suwannee county had their property tax collections account for about 30 percent of their revenue collections. Intergovernmental transfers accounted for about 45 percent of the collected revenues in Columbia and Suwannee, and around 55 percent in Hamilton County.

If these relative magnitudes continue during the 1980's and 1990's, then the taxable value of real and personal property will have to increase assuming no change in the millage rate. The increase in taxable value must reflect more than just inflation since the expenditures are quoted in constant dollars. The taxable value of the property should increase in real terms since firms may expand, houses will be constructed, and land that is now basically idle will be converted into productive use.

During the mid-1970's, taxable values did not rise as rapidly as the rate of inflation--suggesting that, in constant dollars, the taxable value of property actually fell. To overcome the rising prices and the hesitancy of builders and investors in this region to enlarge facilities or construct new housing units, the county officials raised the millage rate, particularly from fiscal 1974 to fiscal 1975. The mid-1970's are abnormal for the high rates of inflation and low rates of employment--conditions that would lend to acute financial problems for those counties relying on a property tax as a major source of revenue.

Baseline projections do not assume the continuation of abnormal circumstances, hence it is suggested that the taxable value of property will rise in constant dollar terms, but it cannot be projected that the constant dollar taxable value will rise in exactly the same proportions as constant dollar expenditures. This means that to raise sufficient revenue millage rates may have to be altered.

Millage rates will also have to be increased if any major reductions are made in intergovernmental transfers. Changes in intergovernmental transfers are, of course, political decisions that cannot be accurately projected for twenty years.

In summary, the natural growth of the local impact area will lead to the demand for additional public services, but the tax side may not respond quite as automatically. The value of property in the three-county area should rise in constant dollar terms, but the rate of increase cannot be reliably projected. Changes in the millage rates may then be necessitated.

2.8.18 PROJECTIONS OF SCHOOL ENROLLMENT AND EXPENDITURES

The one major public service that has not been mentioned is school expenditures and this traditionally is a major public service offered at the local level.

Projections of student enrollment are presented in Table 2.8-52 with the projection for 1980 being based on an estimate by the University of Florida. The projections for 1985 through the year 2000 are based on the population projections and the expected age distribution of the population.

The school age population is projected to rise more rapidly from 1980 to 1985 than from 1975 to 1980 because of an assumed increase in births in the late 1970's. From 1985 through 2000, the school age population is projected to rise more slowly because of the apparent change in the average size of families.

School expenditures are based on the expenditure per student in the local impact area and across the state of Florida and the expected enrollment. During the mid-1970's, both Columbia and Hamilton Counties spent more per student than the average across the state. Suwannee County spent less per student than the average across the State. At the same time, Columbia, Hamilton and Suwannee contributed less locally to their school budgets than other counties in the state.

It was assumed that expenditures per student in Columbia and Hamilton Counties would gradually taper off to the State's average and that expenditure per student in Suwannee County would gradually rise to the state's average. The baseline projections are given in Table 2.8-53.

The projections suggest that Columbia County may be able to reduce its total expenditures in 1974 dollars despite the rising enrollment. This is due to the lowering of the expenditures per student to the average for the state. Hamilton County experiences only very modest increases in its expenditures for education for the same reasons as outlined above.

Suwannee County, on the other hand, will experience rather substantial increases in total expenditures because of a slightly higher rate of growth of school age population than the other counties and because of gradually increasing the money spent per student to the average for the state.

Columbia and Hamilton Counties may choose to continue supporting education of a rate above that of the state as a whole. However. sooner or later, the state may ask counties below the average to support education more intensively at the local level. Hence, it was assumed that the counties will choose to finance education at approximately the same rate as other counties in the state.

In practical terms, these projections suggest that Columbia and Hamilton Counties may not need to concern themselves with expansion of capital facilities, except maintenance, while Suwannee may need to construct new facilities, or, at least expand some of the current facilities.

In the mid-1970's the local impact area collected locally about 21 percent of the total revenues needed to support education with the other revenues coming from the state and the federal governments. On the average, counties in Florida raise about 35 percent of their education revenues through local taxation. This discrepancy is rather substantial and will probably narrow over the next two decades. Local citizens will be forced to pay more just to maintain the same level of educational service without a larger enrollment. Hence, revenues to support education should rise, but locally generated revenues will probably rise more rapidly than other revenue sources.

2.8.19 LAND USE PROJECTIONS

As stated previously, a region's land and the associated characteristics of that land are the basic ingredients of a region's economic and environmental success. The land and its natural endowment provide the potential for persons to earn a decent living and to live a gratifying life. Any major change in the use of the land should be carefully analyzed in terms of private and social costs and benefits. Decisions by private landowners concerning the use of their land should lead to the optimal use of the land from a purely private point of view. However, it can be stated with equal certainty that private owners and users of land will not consider the social or public costs and benefits of land use. This report, by first noting the existing land use in a previous section and now projecting the land use for the next two decades under the baseline projections of population and other variables, will allow officials and residents to consider the social costs and benefits of the natural growth of the local impact area.

Land within a given region is obviously fixed in quantity, assuming that boundaries are not allowed to change. Hence, more land for residential construction must mean less land for other uses or, more land for governmental facilities such as schools must mean less land for other uses such as residential construction. Alternatively, each acre of land could be used more intensively by rising population and other factors inducing builders to build more houses per acre than before. This, of course, suggests a change in the quality of living conditions.

Projected land use in Columbia, Hamilton and Suwannee Counties for the year 2000 are presented in the next sections. Anticipated land use in 1980, 1985 and 1990 are not presented since a smooth monotonic change in land use is expected. Hence, what is important is the end result after twenty years of economic growth.

2.8.19.1 Columbia County

In Table 2.8-54 the existing land use and projected land use for Columbia County are presented. In 1976 approximately 70 percent of the county was in an undeveloped use. Agricultural areas constituted 26.2 percent of the county, thus leaving approximately 4 percent of the land for all other uses. Residential, commercial, industrial, transportation and institutional uses of land are more concentrated in the incorporated areas than in the unincorporated areas. Complete land use data were available for Fort White but not for Lake City. With the data that were available for the incorporated areas and with general knowledge of the Lake City area, estimates were made and included to develop Table 2.8-54.

Within the incorporated areas of Columbia County, residental land use, though more dense than the unincorporated areas, had increased to only slightly over three units per acre in 1976. Houses in the unincorporated areas averaged approximately .86 acres per unit (1.16 houses per acre). In 1976 no problem of overcrowding of people in residential areas seemed evident.

As suggested by the baseline projections of population growth, and considering trends in persons per household, it is estimated that an additional 4,640 new housing units will be needed by the year 2000. Assuming that the acreage of incorporated and unincorporated areas will remain constant, it is projected that an additional 296 acres within the incorporated areas will be dedicated to residential purposes. Correspondingly, an additional 1155 acres of unincorporated land will be transferred to residential use. It is projected that the number of houses per acre within the incorporated area will increase to approximately 3.5 by 2000. An increase in housing density within unincorporated areas is also forecasted. Here, by the year 2000 residential land will have approximately 1.35 houses per acre. It is believed that the concentration of this additional residential land will be transferred from agricultural use near and around Lake City, probably with new suburbs in the form of tract housing. There will also be limited transfer from all types of forest land in the central part of the county. This increase in the number of houses, due to increased population, will require corresponding increases in service-oriented uses of land. As depicted in Table 2.8-54, commercial land use is projected to increase with much of the new commercial construction expected to occur near residential sections in and around Lake City. Transportation land use is also expected to increase, mainly due to new streets in new residential areas and a few additional roads constructed to access these residential areas and the new commercial land use. Only very small increases are projected for communication, utilities and institutional land uses. These increases will be required to satisfy an increased demand created by a larger population.

It is projected that approximately 1700 acres of agricultural land will be transferred to residential, commercial, transportation, industrial and institutional purposes. An additional 500 acres of forest is forecasted to be transferred for these purposes. This transfer appears to be rational and acceptable considering the economic and social benefits associated with these transfers of land use.

It may be concluded, considering the projections to the year 2000, that there are no apparent serious problems of land use in Columbia County. Also any future conflicts of land use are expected to be resolved after careful consideration of the physical, social and economic environmental impacts.

2.8.19.2 Hamilton County

In Table 2.8-55 the existing land use as of 1976 and the projected land use as of the year 2000 are presented. The existing land use pattern suggests that only very small portions of the total acreage of Hamilton County is devoted to residential buildings, commercial establishments, industrial sites, transportation facilities, utility plants, institutional properties, or recreational areas. In fact, in 1976 only 2.7 percent of the total acreage was needed to fulfill the typical requirements of the county's citizens. The rest of the land was in use for agricultural, forest, water, or extractive purposes. There was also a small quantity of open land, that is, land not being used for any expressed purpose at that time.

In 1976, much of the residential land was sparsely used. In fact, over 90 percent of the residential areas in Jasper, Jennings and White Springs were declared to be of low density. Within the incorporated areas (Jennings, Jasper and White Springs), each housing unit was located on one-third of an acre on the average. In most cities and towns, six single unit houses per acre would not be unusual. Outside the incorporated areas each housing unit was located on almost one acre of land on the average. In other words, the existing housing patterns do not suggest a crowded residential section.

By the year 2000, approximately 1,600 new housing units will need to be constructed. If these new houses are divided between incorporated and unincorporated areas in a proportion similar to that which exists in 1976, then approximately 1,000 acres will be needed for construction purposes. This is assuming the same density as in 1976, a very unrealistic assumption. If commercial establishments, industrial sites, etc. expand by approximately the same proportions as the residential land use, then the following land use pattern would develop:

	1976 Land Use (Acres)	2000 Land Use (Acres)
Residential	2,334	3,428
Commercial	434	758
Industrial	1,021	1,634
Transportation	3,358	5,373
Utilities	45	72
Institutional	256	410
Recreation	1,494	2,390
	8,982	11,731

Currently, the above land uses account for 2.7 percent of the total acreage. In the year 2000, these simple extrapolations suggest that 3.6 percent of the total land will be used for the above purposes. This means that some of the less valuable land will have to be developed in an alternative fashion.

The assumptions about the low density per acre of homes and businesses should not be viewed as realistic. As more valuable land has to be converted to home sites or business sites, the price of the land will naturally be higher. The higher price will influence the home builder or the firm's idea about how much land is necessary.

The number of houses per acre will naturally rise and the average size of a business establishment will automatically fall. It was assumed that in 2000 the land required for new houses, new business establishments, etc., will be approximately half of the land required for the same facilities in 1976. For example, if in 1976 two houses were built on an acre, in the year 2000 four houses would be built on that acre. The land use projections in Table 2.8-55 are based on this assumption.

Recreational and institutional land use is assumed to remain constant. There is no reason to expect parks to be expanded in a county such as Hamilton County unless there is an external demand for private recreational facilities to be created. Institutional facilities refer to government buildings, hospitals and schools. Certainly, these buildings will have to be maintained, but there does not seem to be a strong reason to believe that these facilities will have to expand. Schools will not have a large influx of students based on the school enrollment projections. Also, Hamilton County already spends a larger amount per student than the average county in Florida. The school facilities will be more intensively used, but will not be expanded. Government buildings will not have to expand to handle the additional people. More hospital space might be needed, but in small communities many persons use hospital facilities in larger cities such as Lake City in Columbia County.

Alternatively, private clinics may be built but these will be listed as commercial establishments.

Transportation facilities will increase but not as rapidly as other land use. Roads will be built in order to provide access to new homes, but major highways are in place. Hence, in 1976 highways and other transportation facilities covered over 3,358 acres or an average of four-tenths of an acre per capita. For the projected increase in population the acres devoted to transportation will be approximately one-tenth of an acre per additional resident. This assumption will necessitate an additional 320 acres to be devoted to transportation facilities.

In total, 1,329 acres are projected to be converted to residential, commercial, industrial, utility or transportation use. This land will be converted from open land, agricultural land and mixed forests. In summary, the land use patterns in Hamilton County will be only slightly affected by the projected demographic and economic growth over the next two decades. Hamilton County at this point in time can easily accommodate the projected growth in population, houses, etc. over the next twenty years.

It should be noted that extractive land use is projected to remain constant throughout this period. The reason for this is that it is assumed that Occidental Chemical Company already owns rights to all land which they will mine through the period to 2000. All of this land is presumably already classified as extractive. It is, of course, possible that Occidental will acquire the rights to mine other land before 2000. It should be noted, however, that over this period much of their land which is now classified as extractive will be reclaimed and put to other uses, perhaps forestry or recreation. It is, thus, possible that there will be less land in extractive uses by 2000 than there is in 1978.

2.8.19.3 Suwannee County

In Table 2.8-56 the existing land use and the projected land use for Suwannee County are presented. The existing land use pattern suggests that a very small portion of total acreage is used for residential, commercial, industrial, institutional or recreational purposes. In 1974, approximately 2.8 percent of the total acreage was devoted to these land uses. Over 50 percent of the land was devoted to agricultural purposes and just over 45 percent was devoted to forest and natural areas where natural areas refer to land not otherwise developed. The city of Live Oak is not included in this discussion; however, it includes around 300 acres and this land is more intensively used than other land in the county. As a good approximation, about half of the county's population is in Live Oak and about half is outside of the major town.

Given the population and housing baseline projections previously derived, by the year 2000 about 2,500 new homes will be built in Suwannee County, outside of Live Oak. Presently, each existing house is on about one-half acre so if this proportion continues into the future, over 1,250 additional acres will be needed for residential purposes. This suggests that the existing acreage devoted to residential buildings will have to double over the next twenty years. If this is also true for other land uses, this commercial establishments will need 68 acres in the year 2000, industrial users almost 6,000 acres, institutional users almost 9,000 acres, and recreational acres almost 7,500 acres. Together these users would account for 5.7 percent of the total land use in the county.

However, just as in the case of Hamilton County, there is no reason to project the same density rates twenty years into the future. Economic forces will naturally lead to more densely populated regions and to more compactly built business establishments. This will be particularly true if the agricultural land is particularly valuable for agricultural reasons or if the undeveloped area is costly to develop because of the natural conditions and terrain.

In the case of Suwannee County, since Live Oak is not represented, it was assumed that the reaction to higher priced land will cause persons and businesses to seek only 75 percent of an acre for a house or business by the year 2000, whereas in 1974 they would have sought the whole acre. This assumption was used for residential houses, commercial establishments, industrial facilities and institutional users. Institutional users are expected to grow in Suwannee County because of the increase in school enrollment and the need to increase expenditures per pupil. Recreational facilities are not expected to grow unless there is external demand for the use of land in and around the Suwannee River for private recreational facilities. These assumptions are used for the projections presented in Table 2.8-56.

The major conclusion can be stated as follows. The natural demographic and economic growth of next two decades will not alter land use within Suwannee County significantly. The population areas will become slightly more crowded, but there is more than enough land to accommodate the additional people. In the year 2000, Suwannee County will be described in much the same terms as it would be described in 1978.

Table 2.8-1 Population of Florida and Other Southeastern States

State	Population						
	1930	1940	1950	1960	1970	1973	1974
Florida	1,468,211	1,897,414	2,771,305	4,951,560	6,791,418	7,745,000	8,485,230
Alabama	2,646,248	2,832,961	3,061,743	3,226,740	3,451,165	3,548,000	3,577,000
Arkansas	1,854,482	1,949,387	1,909,511	1,786,272	1,932,295	2,035,000	2,062,000
Georgia	2,908,506	3,123,723	3,444,578	3,943,116	4,602,575	4,818,000	4,882,000
Kentucky	2,614,589	2,845,627	2,944,806	3,038,156	3,231,706	3,328,000	3,357,000
Louisiana	2,101,593	2,363,880	2,683,516	3,257,022	3,652,912	3,746,000	3,764,000
Mississippi	2,009,821	2,183,796	2,178,914	2,178,141	2,220,912	2,317,000	2,324,000
North Carolina	3,170,276	2,571,623	4,061,929	4,556,155	5,098,059	5,302,000	5,363,000
South Carolina	1,738,765	1,899,804	2,117,027	2,382,594	2,597,516	2,724,000	2,784,000
Tennessee	2,616,556	2,915,841	3,291,718	3,567,089	3,937,687	4,095,000	4,129,000
Virginia	2,421,851	2,667,773	3,318,680	3,966,949	4,659,494	4,844,000	4,908,000
West Virginia	1,729,205	1,901,974	2,005,552	1,860,421	1,751,237	1,788,000	1,791,000

Source: Florida Statistical Abstract, 1971 & 1976, Bureau of Economic and Business Research, University of Florida.

Table 2.8-2 Population of Local Impact Area and Florida 1960, 1970, 1974, and 1976

	Population				Percent Change			
Three County Area	1960	1970	1974	1976	1970 Over 1960	1974 Over 1970	1976 Over 1970	1976 Over1974
Columbia	20,077	25,250	28,393	28,664	25.8	12.4	13.5	0.9
Hamilton	7,705	7,787	8,195	8,600	1.1	5.2	10.4	4.9
Suwannee	14,961	15,559	17,645	18,918	4.0	13.4	21.5	7.2
Total	42,743	48,596	54,233	56,182	13.7	11.6	15.6	3.6
Florida	4,951,560	6,791,418	8,090,000	8,551,816	37.1	19.1	25.9	5.7

Source: Florida Statistical Abstract, 1971 and 1976.

Table 2.8-3 Components of Change, Florida and Three County Area, 1960 to 1970

	Population		Components of Change		
	1960	1970	Births Minus Deaths	Net Migration	Migration Rate
Florida	4,951,560	6,791,418	511,575	1,328,283	26.8
Three County Area	42,743	48,596	5,400	453	1.1
Columbia	20,077	25,250	2,923	2,250	11.2
Hamilton	7,705	7,787	1,039	-957	-12.4
Suwannee	14,961	15,559	1,438	-840	-5.6

Source: *Florida Statistical Abstract*, 1972.

Table 2.8-4 Components of Change, Florida and Three County Area, 1970 to 1975

	Population		Components of Change		
	1970	1975	Births Minus Deaths	Net Migration	Migration Rate
Florida	6,789,443	8,485,230	150,284	1,543,528	22.7
Three County Area	48,596	56,300	2,241	5,463	11.3
Columbia	25,250	28,793	1,319	2,224	8.8
Hamilton	7,787	8,641	343	511	6.6
Suwannee	15,559	18,866	579	2,728	17.5

Source: Florida Statistical Abstract, 1976.

Table 2.8-5 Population By Age, Sex, and Race, For Local Impact Area, 1976

Age	Total	White	Nonwhite	Male	Female
Columbia County					
0-17	9,946	7,439	2,507	4,902	5,044
18-64	15,935	13,035	2,900	7,747	8,188
65 +	2,783	2,037	746	1,155	1,628
Total	28,664	22,511	6,153	13,804	14,860
Hamilton County					
0-17	3,049	1,663	1,386	1,550	1,499
18-64	4,402	2,994	1,408	2,033	2,369
65 +	1,149	796	353	494	655
Total	8,600	5,453	3,147	4,077	4,523
Suwannee County					
0-17	6,170	4,554	1,616	3,184	2,986
18-64	10,195	8,509	1,686	4,719	5,476
65 +	2,553	2,079	474	1,092	1,461
Total	18,918	15,142	3,776	8,995	9,923
Three County Area					
0-17	19,165	13,656	5,509	9,636	9,529
18-64	30,532	24,538	5,994	14,499	16,033
65 +	6,485	4,912	1,573	2,741	3,744
Total	56,182	43,106	13,076	26,876	29,306

Source: Population Studies, University of Florida, Bureau of Economic and Business Research, June 1977.

Table 2.8-6 Selected Characteristics of the Employment Structure, State of Florida and the Local Impact Area, 1970

Characteristic	Florida	Local Impact Area Columbia	Hamilton	Suwannee	Total
Total Population	6,791,418	25,250	7,787	15,559	48,596
Civilian Labor Force	2,521,245	9,432	2,596	5,703	17,731
Total Employment	2,426,268	9,134	2,584	5,585	17,703
Total Unemployment	94,977	298	12	118	428
Rate of Unemployment	3.8	3.2	0.0	2.1	2.4
Construction Employment	206,265	702	166	400	1,268
Manufacturing Employment	341,836	1,447	378	755	2,580
Chemical & Other Industries	17,859	102	107	43	252
Agricultural Employment	110,994	655	461	981	2,097

Source: U.S. Census of Population, Florida, 1970.

Table 2.8-7 Selected Characteristics of the Employment Structure, State of Florida and Local Impact Area, 1974

Characteristics	Florida	Local Impact Area			Total
		Columbia	Hamilton	Suwannee	
Total Population	8,485,230	28,393	8,195	17,645	54,233
Civilian Labor Force	3,520,000	13,000	4,700	7,400	25,100
Total Employment	3,174,600	11,800	4,500	6,700	23,000
Total Unemployment	345,400	1,200	200	700	2,100
Rate of Unemployment	9.8	9.3	4.4	9.4	8.4
Construction Employment	190,000	280	160	180	620
Manufacturing Employment	329,500	1,480	80	360	1,920
Other Industries	2,797,300	9,300	3,400	4,560	17,260
Agricultural Employment	NA	360	300	680	1,340

Source: Florida Statistical Abstract, 1976.

Table 2.8-8 Employment Structure by Industry, State of Florida and Local Impact Area, 1975

	Agriculture	Construction	Finance & Ins. And Real Estate	Government	Manufacturing	Services Mining & Misc.	Trade	Transportation Communication And Utilities
Florida	111,000	190,000	188,400	560,700	329,500	605,000	737,900	185,800
Three County Area								
Columbia	360	280	280	3,440	1,480	1,340	2,180	300
Hamilton	300	160	40	640	80	2,100	340	40
Suwannee	680	180	220	1,220	360	580	1,560	440
Total	1,340	620	540	5,300	1,920	4,020	4,080	780

Source: Florida Statistical Abstract, 1976.

Table 2.8-9 Employment At Occidental Chemical Company By County Where Employee Lives, 1974 - 1977*

County	1974	1975	1976	1977
Columbia	335	402	407	463
Hamilton	355	498	448	435
Suwannee	223	365	258	228
Other**	119	98	133	59
Total	1,032	1,363	1,246	1,185

* As of December 31, except 1977 when it is as of September.

** Including Georgia

Source: Occidental Chemical Company.

Table 2.8-10 Personal Income By Place of Residence in Current Dollars, Florida and Local Impact Area, 1970 and 1974 (Millions of Dollars)

	1970	1974
Florida	$25,596	$43,783
Three County Area	$ 129	$ 233
Columbia	$ 71	$ 121
Hamilton	$ 17	$ 36
Suwannee	$ 42	$ 76

Source: Florida Statistical Abstract, 1976.

Table 2.8-11 Per Capita Income by Place of Residence for Florida and the Local Impact Area, 1965, 1970 and 1974 (In Current Dollars)

	1965	1970	1974
Florida	$2,404	$3,738	$5,412
Three-County Area			
Columbia	1,813	2,784	4,287
Hamilton	1,840	2,122	4,595
Suwannee	1,798	2,703	4,385

Source: Florida Statistical Abstract, 1976.

Table 2.8-12 Comparison of Income by Place of Residence and Income By Place of Work, Florida and Local Impact Area, 1974 (In Millions of Dollars)

	Place of Residence	Place of Work
Florida	43,783	43,808
Three County Area	233	228
Columbia	121	116
Hamilton	36	42
Suwannee	76	70

Source: Florida Statistical Abstract, 1976.

Table 2.8-13 Personal Income, Earned Income, and Wages and Salaries, Florida and Local Impact Area, 1971 and 1974, (In Millions of Dollars)

	Personal Income	Earned Income	Wages and Salaries
1971			
Florida	28,053	24,269	17,085
Three County Area	146	130	93
Columbia	79	70	53
Hamilton	23	21	14
Suwannee	44	39	26
1974			
Florida	43,808	30,625	26,121
Three County Area	228	183	132
Columbia	116	92	73
Hamilton	42	37	25
Suwannee	70	54	34

Source: Florida Statistical Abstract, 1976.

Table 2.8-14 Selected Housing Characteristics for Florida and the Three-County Area for 1960

	Florida	Three-County Area			
		Total	Columbia	Hamilton	Suwannee
Total Housing Units	1,776,961	13,470	6,377	2,345	4,748
Occupied Units	1,550,414	11,876	5,587	2,058	4,231
Owner	1,047,217	7,878	3,628	1,220	3,030
Renter	503,197	3,998	1,959	838	1,201
Vacant	163,016	1,337	726	246	365
For sale	38,471	117	69	10	38
For rent	73,375	349	195	62	92
Other	51,170	871	462	174	235
Total Year Round Units	1,713,430	13,213	6,313	2,304	4,596
Mobile Home or Trailer	65,087	221	93	30	98

Source: Florida Statistical Abstract, 1971.

Table 2.8-15 Selected Housing Characteristics for Florida and the Three-County Area for 1970

	Florida	Three-County Area			
		Total	Columbia	Hamilton	Suwannee
Total Housing Units	2,522,080	16,239	8,450	2,562	5,227
Occupied Units	2,275,008	14,862	7,661	2,351	4,850
Owner	1,560,319	10,801	5,522	1,645	3,634
Renter	714,689	4,061	2,139	706	1,216
Vacant	202,370	1,347	776	203	368
For sale	27,985	122	83	10	29
For rent	85,611	428	227	50	151
Other	88,774	797	466	143	188
Total Year Round Units	2,484,841	16,230	8,445	2,562	5,223
Mobile Home or Trailer	150,064	1,304	712	213	379

Source: Florida Statistical Abstract, 1971.

Table 2.8-16 Florida Tax and Revenue Collections--Total Revenue, Revenue From Taxes, and Revenue From Selected Taxes for Fiscal 1966-67 to Fiscal 1975-76 (in Thousands of Dollars).

Year	Total Revenue Operating Expenses	Revenue From Tax Sources	Sales Tax Collections	Corporate Income Tax	Severance Tax On Solid Minerals
1966-67	$1,397,833	$ 960,077	$ 300,872		
1967-68	1,507,748	1,052,700	357,683		
1968-69	1,873,042	1,371,088	573,779		
1969-70	2,111,572	1,539,367	658,197		
1970-71	2,437,487	1,717,277	715,191		
1971-72	3,033,735	2,152,700	875,767	$ 27,873	
1972-73	3,633,587	2,582,796	1,041,145	147,708	$ 2,694
1973-74	4,031,603	2,907,113	1,196,342	188,777	3,489
1974-75	4,344,935	2,921,059	1,199,521	180,256	9,790
1975-76	4,659,167	3,143,110	1,254,086	180,740	21,006

Source: Florida Statistical Abstract, 1971 and 1972, and Annual Report of the Comptroller, 1975-76.

Table 2.8-17 Occidental Severance Tax Payments for 1974-1976 (In Dollars)

	1974	1975	1976
Gross Levy	$724,470	$1,530,478	$1,802,641
Ad Valorem Tax Credit	4,191	8,515	13,927
Net Tax	720,279	1,521,963	1,788,714
Refund for Reclamation	120,361	248,610	493,392

Source: Occidental Chemical Company.

Table 2.8-18 Local Public Expenditures, Excluding School Districts, Columbia, Hamilton, and Suwannee Counties For Fiscal 1974 - Fiscal 1976 (In Dollars)

	Columbia			Hamilton			Suwannee		
	1976	1975	1974	1976	1975	1974	1976	1975	1974
General Government	974,312	951,146	918,649	798,045	596,238	454,189	1,137,082	883,130	699,420
Public Safety	1,670,339	1,264,204	1,025,489	432,336	413,870	294,418	775,325	668,464	451,470
Physical Environments	184,542	380,548	80,433	32,181	25,457	23,616	53,494	67,743	47,781
Transportation	1,619,424	1,063,292	1,142,907	992,303	668,441	646,383	1,129,177	1,173,282	1,214,719
Economic Assistance	115,443	104,922	75,376	26,121	24,278	28,972	79,994	78,427	58,357
Health	115,905	48,592	30,398	196,493	154,717	45,000	135,720	118,892	115,452
Recreation	269,206	166,573	35,947	24,338	20,360	28,972	139,171	112,978	56,975
Utilities	2,307,387	987,127	1,107,288	514,843	555,980	912,777	1,652,620	957,906	1,343,326
Other	13,066	9,793	271,185	0	6,689	20,218	0	493,077	16,026
Total	7,269,624	4,976,197	4,687,672	3,016,660	2,466,030	2,454,545	5,102,583	4,558,899	4,003,526

Source: Local Government Financial Report, Department of Banking and Finance, State of Florida, Fiscal Years 1973-74, 1974-75, and 1975-76.

Table 2.8-19 Local Revenue Collections, Excluding School Districts, Columbia, Hamilton, and Suwannee Counties For Fiscal 1974 - Fiscal 1976 (In Dollars)

	Columbia			Hamilton			Suwannee		
	1976	1975	1974	1976	1975	1974	1976	1975	1974
TAXES									
Property	1,217,240	1,051,670	622,245	575,305	501,557	394,787	1,218,576	1,037,639	873,481
Other	474,946	417,075	273,557	98,775	80,106	61,795	298,024	256,437	232,529
Licences and Permits	96,175	77,005	54,500	17,278	23,010	12,484	77,947	44,525	46,318
Intergovernmental Revenues	2,660,597	1,961,174	2,461,025	1,412,237	1,176,411	1,144,328	2,164,129	1,596,617	1,456,535
Charges for Services	211,738	145,810	89,782	46,730	102,517	31,624	178,435	181,849	81,769
Fines	242,849	235,816	205,625	120,039	121,657	93,246	130,559	117,804	84,617
Miscellaneous	469,905	435,150	209,736	234,726	115,826	129,344	202,449	130,187	68,187
Utilities	1,812,837	1,430,298	1,540,192	452,571	315,723	280,949	578,193	510,579	476,671
Non-Revenue Collections	63,816	67,877	0	559,295	95,394	0	590,789	809,596	0
Total	7,250,103	5,821,875	5,456,662	3,516,956	2,523,201	2,148,557	5,439,101	4,685,233	3,320,107

Source: Local Government Financial Report, Department of Banking and Finance, State of Florida, Fiscal Years 1974-75, and 1975-76.

Table 2.8-20 Public Expenditures Per Capita in 1976 for Columbia, Hamilton, and Suwannee Counties (In Dollars)

Expenditure	Columbia	Hamilton	Suwannee
General Government	33.99	92.80	60.11
Public Safety	58.27	50.27	40.98
Transportation	56.50	115.38	59.69
Recreation	9.39	2.83	7.35

Table 2.8-21 Property Taxes Per Capita for 1974 - 1976, Columbia, Hamilton, and Suwannee Counties (In Dollars).

Fiscal Year	Columbia	Hamilton	Suwannee
1974	21.92	48.17	49.50
1975	36.53	58.04	55.00
1976	42.46	66.90	64.41

Table 2.8-22 Assessed Value, Taxable Value, and Millage Rates For Columbia, Hamilton, and Suwannee Counties For 1974-1976 (In Millions of Dollars)

	Real Property		Personal Property		
	Assessed Value	Taxable Value	Assessed Value	Taxable Value	Millage* Rate
Columbia					
1974	$303.0	$147.3	$69.9	$35.9	$4.12
1975	310.3	152.5	73.9	39.8	4.93
1976	320.2	161.4	76.4	45.6	4.93
Hamilton					
1974	133.5	39.3	18.3	17.0	6.05
1975	135.8	40.9	29.3	26.5	8.12
1976	137.9	43.8	60.4	54.7	8.12
Suwannee					
1974	146.9	40.4	77.9	33.2	6.70
1975	159.8	48.6	87.1	39.1	8.09
1976	167.4	49.1	92.7	40.5	8.40

Source: Florida Ad Valorem Valuations and Tax Data, 1974-1976.

* Dollars of Taxes Per Thousand Dollars of Taxable Value.

Table 2.8-23 School Enrollment For Local Impact Area By Grades, September, 1975

	Kindergarten, 1 - 3 Grades	4 - 10	11 & 12	All Grades
Columbia	2,106	3,622	539	6,267
Hamilton	719	1,104	117	1,940
Suwannee	1,357	2,592	367	4,316
Florida	404,169	835,356	143,991	1,383,516

Source: Florida Statistical Abstract, 1976.

Table 2.8-24 Projected School Enrollment Through 1980 For Local Impact Area

	1976-77	1977-78	1978-79	1979-80
Columbia	7,062	6,993	6,937	6,890
Hamilton	2,182	2,174	2,137	2,104
Suwannee	4,875	4,967	4,972	4,959
Florida	1,570,918	1,579,003	1,582,222	1,587,201

Source: Florida Statistical Abstract, 1976.

Table 2.8-25 School Revenues By Source For Local Impact Area, School Year 1974 - 1975 (In Thousands of Dollars)

	Total Revenue	Federal	Federal Through State	State	Local
Columbia	9,558	118	1,108	6,307	2,025
Hamilton	3,458	11	456	2,300	691
Suwannee	6,262	0	516	4,450	1,296
Florida	2,112,775	57,827	151,662	1,150,956	752,330

Source: Florida Statistical Abstract, 1976.

Table 2.8-26 School Expenditures for Local Impact Area, School Year 1974-1975 (In Thousands of Dollars)

	Total Expenditures	Administration	Operating Expenses	Capital Outlay	Debt Service
Columbia	12,597	607	8,085	4,020	491
Hamilton	3,549	122	2,923	337	289
Suwannee	6,083	180	5,215	538	319
Florida	2,252,219	77,954	1,885,982	272,824	92,618

Source: Florida Statistical Abstract, 1976.

NOTE: Detail may not add to totals because of rounding.

Table 2.8-27 Existing Land Use In Hamilton County, 1976, Unincorporated Area (In Acres)

	Acres	Percent Of County
Residential	1,883	1.6
Commercial	355	.1
Industrial	1,010	.3
Transportation	2,872	.9
Communications & Utilities	27	.1
Institutional	139	.1
Recreational	1,248	.4
Agricultural	63,633	19.0
Specialty Farms	5,950	2.0
Hardwood Forest	2,215	.7
Mixed Forest	39,587	12.0
Planted Forest	177,790	54.0
Clear Cut	5,037	2.0
Water	820	.3
Wetland - Hardwood	9,930	3.0
Wetland - Mixed Forest	1,630	.5
Extractive	10,127	3.0
Incorporated Area	3,325	1.0
Total	327,578	100.0

Source: Comprehensive Planning Program, Hamilton County, Inventory, 1976. Prepared by Barr, Dunlop, and Associates.

Table 2.8-28 Existing Land Use Within Jasper, Jennings, and White Springs, 1976.

	Jasper		Jennings		White Springs	
	Acres	Percent	Acres	Percent	Acres	Percent
Residential	285.4	30.2	82.5	7.3	83.0	6.7
Commercial	52.5	5.6	56.8	5.0	9.3	0.7
Industrial	4.4	0.5	4.4	0.4	2.0	0.2
Transportation	199.8	21.1	168.3	14.8	118.4	9.5
Communication and Utilities	11.0	1.2	6.7	0.6	.3	0.0
Institutional	84.6	8.9	15.2	1.3	17.7	1.4
Recreational	16.2	1.7	1.9	0.2	227.6	18.3
Open Land	154.0	16.3	88.0	7.8	59.0	4.7
Agricultural	72.0	7.6	65.0	5.7	147.0	11.8
Mixed Forest	46.0	4.9	575.0	50.7	579.0	46.5
Planted Forest	4.0	0.4	70.0	6.2	1.6	0.1
Water	16.0	1.7	0.0	0.0	0.0	0.0
Total	945.9	100.0	1,133.8	100.0	1,244.9	100.0

Source: Comprehensive Planning Program, Hamilton County, Inventory, 1976. Prepared by Barr, Dunlop and Associates.

Table 2.8-29 Existing Land Use in Suwannee County, 1974.

	Acres	Percent
Residential	1,340	.3
Commercial	34	.1
Industrial	2,992	.7
Institutional	4,444	1.0
Recreation	3,167	.7
Agricultural	224,302	51.5
Forest and Natural Area	198,810	45.7
Total	435,405	100.0

Source: Comprehensive Development Plan, Suwannee County, 1974. Prepared by Barr, Dunlop, and Associates.

Note: Exclusive of Live Oak.

Table 2.8-30 Existing Land Use in Columbia County for 1976
(Unincorporated Area)

	Acres	Percentage of County
Residential	5,723	1.1
Commercial	419	0.1
Industrial	345	0.1
Transportation	4,982	1.0
Communications and Utilities	112	--
Institutional	329	0.1
Recreational	2,845	0.6
Mixed	90	--
Agricultural	130,826	25.9
Groves	184	--
Specialty Farms	511	0.1
Hardwood Forest	1,224	0.2
Mixed Forest	46,130	9.1
Planted Forest	177,322	35.2
Clear Cut	2,828	0.6
Water	1,751	0.3
Wetland-Mixed Forest	33,522	6.6
Wetland-Vegetated/Nonforest	11,865	2.4
Wetland-Nonvegetated	215	--
Extractive	450	.1
Oceola National Forest	77,802	15.4
Incorporated	5,369	1.1
Total	504,844	100.0

Source: Comprehensive Planning Program, Columbia County, Inventory, 1976. Prepared by Barr, Dunlop, and Associates.

Table 2.8-31 Existing Land Use for the City of Fort White, Florida

	Acres	Percentage of City
Residential	52.11	3.6
Commercial	4.99	0.3
Transportation	112.66	7.7
Utilities	6.02	0.4
Institutional	23.65	1.6
Open Land	59.24	4.0
Agricultural	417.33	28.4
Forest	793.00	54.0
Total	1,469.00	100.0

Source: Comprehensive Planning Program, Columbia County, Inventory, 1976. Prepared by Barr, Dunlop, and Associates.

Table 2.8-32 Population Growth in Duval County--1960, 1965, 1970, 1973, 1976.

	Population	Percentage Change from Previous Estimate
1960 (April)	455,400	
1965 (July)	508,900	11.7
1970 (April)	528,900	3.9
1973 (July)	558,800	5.6
1974 (July)	570,400	2.1
1975 (July)	578,300	1.4
1976 (July)	579,700	0.2

Source: 1960 and 1970 data from U.S. Censuses of Population. Other years from Division of Business of Economic Research, University of Florida.

Table 2.8-33 Nonagricultural Employment By Industry for Florida and Jacksonville SMSA for March, 1976 (In Thousands)

Industry	Florida	Percent of Total	Jacksonville SMSA	Percent of Total
All Industries	2,797	100.0	256	100.0
Contract Construction	190	6.8	15	5.8
Finance, Insurance, and Real Estate	188	6.7	27	10.5
Government	561	20.0	52	20.3
Manufacturing	330	11.8	29	11.3
Services, Mining, and Miscellaneous	605	21.6	46	17.9
Transportation and Communications	186	6.6	21	8.2
Wholesale and Retail Trade	738	26.4	67	26.2

Source: Florida Department of Commerce.

Table 2.8-34 Personal Income and Per Capita Income by Place of Work for Florida and Duval County for the Years 1969, 1974 and 1975

	Personal Income (Millions of Dollars)		Per Capita Income (Dollars)	
	Florida	Duval	Florida	Duval
1969	$22,871	$1,734	$3,444	$3,274
1974	43,742	2,983	5,406	5,322
1975	47,069	3,221	5,604	5,646

Source: Florida Statistical Abstract and Survey of Current Business.

Table 2.8-35 Revenue and Public Expenditures for Duval County for Fiscal 1975-76 (In Dollars)

Revenues	Amount	Expenditures	Amount
Tax Sources		General Government	$ 31,175,226
Property Tax	$ 42,157,090	Public Safety	49,249,509
Other Taxes	18,380,437		
Licenses and Permits	3,494,606	Physical Environment	8,434,128
Intergovernmental Revenues	83,924,491	Transportation	18,480,094
		Economic Assistance	28,793,245
Charges for Services	7,214,188	Health	14,944,759
Fines	3,050,226	Recreation	9,205,909
Miscellaneous	13,299,976	Other	13,191,500
Nonrevenue Funds	20,745,129		
Total	$192,266,143	Total	$173,474,370

Source: Local Government Financial Report, Fiscal Year 1975-76, by Department of Banking and Finance.

Table 2.8-36 Alternative Population Projections For State of Florida, Through The Year 2000, (In Thousands)

	University Of Florida[1]	OBERS[2]	Department Of Commerce[3]
1960	4,951*	4,951*	4,951*
1970	6,848*	6,848*	6,848*
1975	8,485**	8,485**	8,485**
1980	9,878	8,197	8,926
1985	11,218	NA	NA
1990	12,410	9,913	10,978
2000	14,545	11,767	NA

* Actual as calculated by Bureau of Census

** Revised estimate by University of Florida

1) Florida Statistical Abstract, 1976.

2) Projections for U.S. Water Resources Council, 1972.

3) "State Projections of Income, Employment, and Population," Survey of Current Business (April, 1974).

Table 2.8-37 Population Projections for the Local Impact Area Through the Year 2000 (University of Florida Estimates)

	Columbia		Hamilton		Suwannee		Total	
Year	Population	Annual % Change	Population	Annual % Change	Population	Annual % Change	Population	Annual % Change
1960	20,077	--	7,705	--	14,961	--	42,743	--
1970	25,250	2.3	7,787	0.2	15,559	0.4	48,679	1.3
1976	28,664	2.7	8,600	1.8	18,918	4.0	56,182	2.9
1980	31,600	1.9	9,600	2.2	22,300	3.3	63,500	2.5
1985	34,200	1.6	10,400	1.6	25,000	2.3	69,600	1.8
1990	36,700	1.4	10,900	0.9	26,600	1.2	74,200	1.3
2000	41,600	1.3	11,800	0.8	28,600	0.7	82,000	1.0

Table 2.8-38 Projected Civilian Labor Force Through the Year 2000 (By Place of Residence).

Year	Florida	Three-County Area			
		Columbia	Hamilton	Suwannee	Total
1970	2,521,245	9,432	2,596	5,703	17,731
1980	4,049,900	12,956	3,360	9,143	25,459
1985	4,599,380	14,022	3,640	10,250	27,912
1990	5,080,100	15,047	3,815	10,906	29,768
2000	5,968,450	17,056	4,130	11,726	32,912

Table 2.8-39 Projected Employment, Through Year 2000, (By Place of Residence)

	Florida	Three County Area			
		Columbia	Hamilton	Suwannee	Total
1970	2,426,268	9,134	2,584	5,585	17,703
1980	3,847,481	12,308	3,192	8,686	24,186
1985	4,369,411	13,321	3,458	9,738	26,517
1990	4,833,695	14,295	3,624	10,361	28,280
2000	5,665,278	16,203	3,924	11,140	31,267

Table 2.8-40 Projected Employment by Industry for Columbia County Through the Year 2000 (By Place of Employment)

Industry	1975	1980	1985	1990	2000
Agriculture	360	400	433	489	555
Construction	280	313	339	364	412
Finance, Ins., Real Estate	280	313	339	364	412
Government	3,440	3,847	4,164	4,468	5,065
Manufacturing	1,480	1,653	1,790	1,920	2,177
Services and Mining	1,340	1,502	1,626	1,745	1,978
Trade	2,180	2,442	2,643	2,837	3,215
Transportation	300	335	363	389	441

Table 2.8-41 Projected Employment by Industry for Hamilton County Through the Year 2000 (By Place of Employment)

Industry	1975	1980	1985	1990	2000
Agriculture	300	336	364	381	413
Construction	160	178	193	202	219
Finance, Ins., Real Estate	40	46	49	51	56
Government	640	717	777	815	881
Manufacturing	80	91	99	103	112
Services and Mining	2,100	2,355	2,552	2,674	2,895
Trade	340	381	413	433	469
Transportation	40	46	49	51	56

Table 2.8-42 Projected Employment by Industry for Suwannee County Through the Year 2000 (By Place of Employment)

Industry	1975	1980	1985	1990	2000
Agriculture	680	853	955	1,017	1,093
Construction	180	225	252	268	288
Finance, Ins., Real Estate	220	278	311	331	356
Government	1,220	1,540	1,727	1,837	1,975
Manufacturing	360	456	511	544	585
Services and Mining	580	734	823	875	941
Trade	1,560	1,970	2,208	2,349	2,526
Transportation	440	555	622	662	712

Table 2.8-43 Income Per Capita In Florida and Local Impact Area, 1965, 1970, 1974 (By Place of Residence)

	Annual Growth in Real Percapita Income		Nominal Per Capita Income (In Dollars)					
	1970 Over 1965	1974 Over 1970	1965	% Of State	1970	% Of State	1974	% Of State
Florida	5.38	2.90	2,404	100	3,738	100	5,412	100
Columbia	5.08	4.70	1,813	75	2,784	74	4,287	79
Hamilton	-1.02	14.60	1,840	77	2,122	57	4,595	85
Suwannee	4.68	6.10	1,798	75	2,703	72	4,385	81

Source: Florida Statistical Abstract, 1976.

Table 2.8-44 Projected Real Per Capita Income for Florida & Local Impact Area, Through Year 2000 (In 1974 Dollars)

		Local Impact Area			
Year	Florida	Columbia	Hamilton	Suwannee	Total
1974	5,412	4,287	4,595	4,385	4,443
1980	6,276	5,020	5,334	5,020	5,067
1985	7,276	5,820	5,820	5,820	5,820
1990	8,435	6,748	6,748	6,748	6,748
2000	11,335	9,068	9,068	9,068	9,068

Table 2.8-45 Projected Personal Income for Florida Local Impact Area Through the Year 2000 (In Millions of 1974 Dollars)

		Local Impact Area			
Year	Florida	Columbia	Hamilton	Suwannee	Total
1974	$ 43,808.0	$116.0	$ 42.0	$ 70.0	$228.0
1980	60,404.0	150.0	55.0	93.0	298.0
1985	79,320.0	187.0	69.0	115.0	371.0
1990	101,235.0	232.0	84.0	142.0	458.0
2000	158,726.0	354.0	121.0	212.0	687.0

Table 2.8-46 Persons Per Housing Unit for Florida and the Three-County Area for 1960 and 1970.

	1960	1970	% Reduction
Florida	2.78	2.71	- 2.5
Three-County Area			
Columbia	3.13	2.99	- 4.5
Hamilton	3.30	3.04	- 7.9
Suwannee	3.19	2.98	- 6.5

Source: U.S. Census of Population and Housing, 1960 and 1970.

Table 2.8-47 Projected Persons Per Household and Total Housing Requirements for Florida and Local Impact Area Through the Year 2000

	Persons Per Housing Unit				Housing Units			
		Three-County Area				Three-County Area		
Year	Florida	Columbia	Hamilton	Suwannee	Florida	Columbia	Hamilton	Suwannee
1970	2.71	2.99	3.04	2.98	2,522,080	8,450	2,562	5,227
1980	2.50	2.60	2.65	2.60	3,951,200	12,152	3,622	8,577
1985	2.60	2.70	2.75	2.70	4,314,615	12,666	3,782	9,259
1990	2.70	2.80	2.85	2.80	4,596,296	13,107	3,824	9,500
2000	2.70	2.80	2.85	2.80	5,387,037	14,857	4,140	10,214

Table 2.8-48 Baseline Projections For Sales Tax Collections And Corporate Income Tax Collections For Florida Through Year 2000 (In Thousands of 1974 Dollars)

Fiscal Year	Sales Tax Collections	Corporate Income Tax Collections
1980 - 1981	2,190,359	328,554
1975 - 1986	2,723,773	408,566
1990 - 1991	3,476,301	521,445
2000 - 2001	5,450,473	817,571

Table 2.8-49 Projected Public Services For Columbia County Through Year 2000 (In Thousands of 1974 Dollars)

Public Service	Years				
	1974	1980	1985	1990	2000
General Government	918	1,022	1,106	1,187	1,345
Public Safety	1,025	1,141	1,235	1,325	1,502
Transportation	1,143	1,272	1,376	1,477	1,674
Recreation	36	40	43	46	52
Physical Environment	80	89	97	103	118
Economic Assistance	75	83	90	97	110
Health	30	34	37	39	44
Total	3,307	3,682	3,984	4,276	4,847

Table 2.8-50 Projected Public Services For Hamilton County Through Year 2000 (In Thousands of 1974 Dollars)

Public Service	Years				
	1974	1980	1985	1990	2000
General Government	454	532	576	604	654
Public Safety	294	345	373	391	424
Transportation	646	757	820	860	931
Recreation	29	34	37	38	41
Physical Environment	22	28	30	31	34
Economic Assistance	29	34	37	38	42
Health	27	53	58	60	65
Total	1,501	1,782	1,930	2,023	2,190

Table 2.8-51 Projected Public Services For Suwannee County Through Year 2000 (In Thousands of 1974 Dollars)

Public Service	Years				
	1974	1980	1985	1990	2000
General Government	699	883	990	1,054	1,133
Public Safety	451	570	639	680	731
Transportation	1,215	1,535	1,721	1,831	1,969
Recreation	57	72	80	86	92
Physical Environment	48	60	68	72	77
Economic Assistance	58	74	83	88	95
Health	115	145	164	174	187
Total	2,643	3,341	3,746	3,985	4,285

Table 2.8-52 Baseline Projections for School Enrollment for Local Impact Area Through the Year 2000 (Grades Kindergarten Through High School).

Year	Florida	Local Impact Area		
		Columbia	Hamilton	Suwannee
1975	1,383,516	6,267	1,941	4,317
1980	1,587,201	6,890	2,104	4,959
1985	1,778,320	7,682	2,300	5,748
1990	2,021,840	8,316	2,405	6,192
2000	2,277,990	9,005	2,527	6,976

Table 2.8-53 Baseline Projections for School Expenditures in the Local Impact Area Through the Year 2000 (In Thousands of 1974 Dollars).

Year	Florida	Local Impact Area		
		Columbia	Hamilton	Suwannee
1974-1975	$2,252,219	$12,597	$3,549	$ 6,083
1980-1981	2,587,137	12,402	3,576	7,438
1985-1986	2,898,662	12,522	3,759	9,369
1990-1991	3,295,599	13,555	3,920	10,092
2000-2001	3,713,124	14,678	4,119	11,370

Table 2.8-54 Projected Land Use for Columbia County in Year 2000

	Existing Land Use, 1976		Projected Land Use, 2000	
	Total	Percentage	Total	Percentage
Residential	7,118	1.4	8,526	1.7
Commercial	741	.1	888	.2
Industrial	452	.1	542	.1
Transportation	5,787	1.1	6,338	1.3
Communication & Utilities	165	-	177	-
Institutional	865	.2	870	.2
Recreation	2,892	.6	2,892	.6
Mixed	110	-	110	-
Agricultural	132,437	26.2	130,764	25.9
Groves	184	-	184	-
Specialty	511	.1	511	.1
Hardwood Forest	1,324	.3	1,324	.3

Table 2.8-54 (Continued)
-2-

	Existing Land Use, 1976		Projected Land Use, 2000	
	Total	Percentage	Total	Percentage
Mixed Forest	46,230	9.2	45,730	9.1
Planted Forest	177,422	35.1	177,422	35.1
Clear Cut	2,928	.6	2,928	.6
Water	1,824	.4	1,824	.4
Wetland-Mixed Forest	33,522	6.6	33,522	6.6
Wetland-Vegetated/Non Forest	11,865	2.4	11,865	2.4
Wetland-Non Vegetated	215	-	215	-
Extractive	450	.1	450	.1
Osceola National Forest	77,802	15.4	77,802	15.4
TOTAL	504,844	99[a]	504,884	100.1[a]

[a] Not equal 100.0 due to rounding.

Table 2.8-55 Projected Land Use For Hamilton County In Year 2000 (Incorporated and Unincorporated Areas)

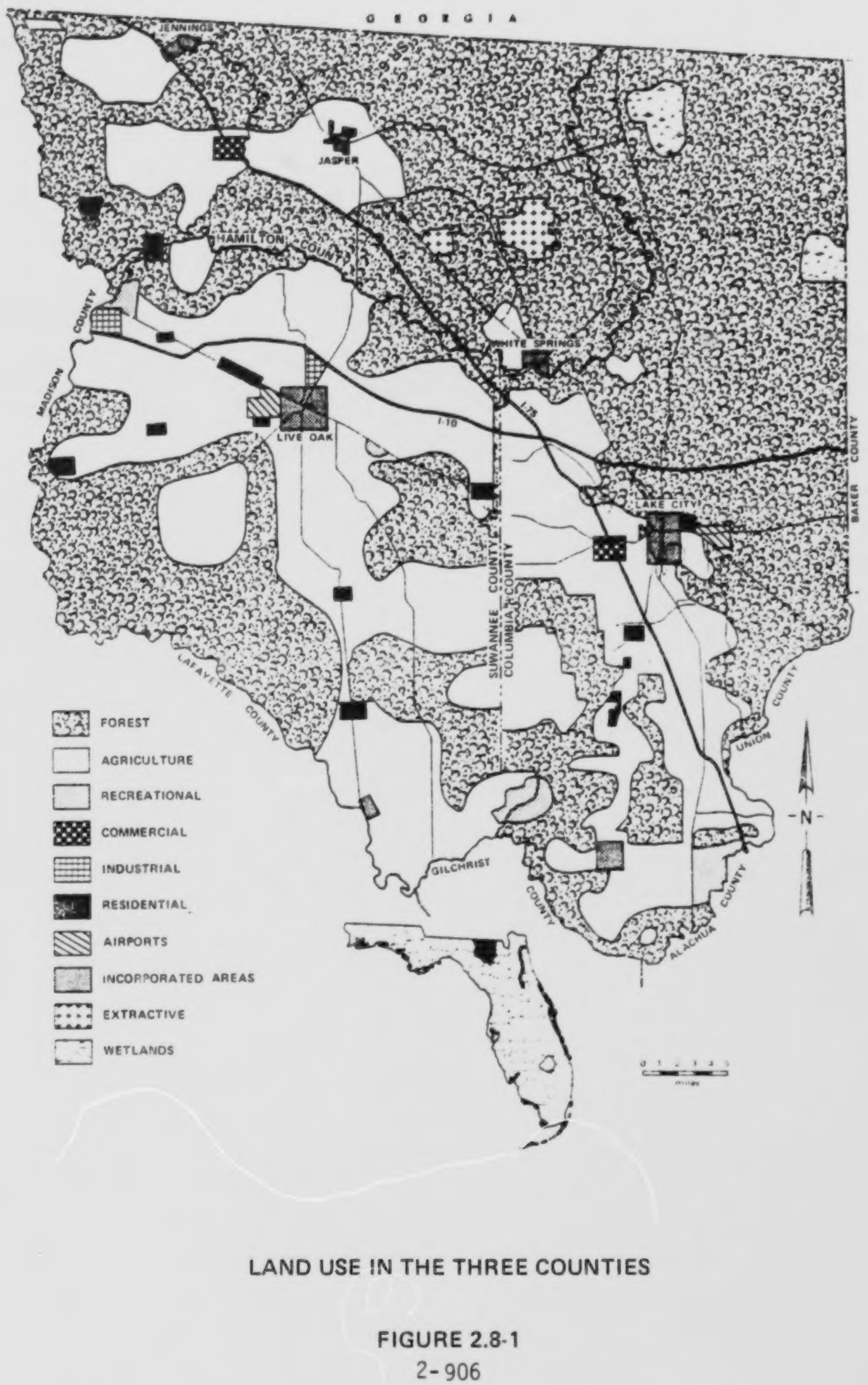
	Existing Land Use, 1976		Projected Land Use, 2000	
	Acres	Percent Of Acres	Acres	Percent Of Acres
Residential	2,333.9	0.7	2,881.0	0.9
Commercial	473.6	0.1	616.0	0.2
Industrial	1,020.8	0.3	1,327.5	0.4
Transportation	3,358.5	1.0	3,678.5	1.1
Communications and Utilities	45.0	0.1	58.5	0.1
Institutional	256.5	0.1	256.5	0.1
Recreational	1,493.7	0.4	1,493.7	0.4
Agricultural	63,917.0	19.4	63,369.0	19.2
Specialty Farms	5,950.0	2.0	5,950.0	2.0
Hardwood Forest	2,215.0	0.7	2,215.0	0.7
Mixed Forest	40,787.0	12.3	40,087.0	12.1
Planted Forest	177,865.6	54.2	177,865.6	54.2
Clear Cut	5,037.0	2.0	5,037.0	2.0
Water	836.0	0.2	836.0	0.2
Wetland/Hardwood	9,930.0	3.0	9,930.0	3.0
Wetland/Mixed Forest	1,630.0	0.5	1,630.0	0.5
Extractive	10,127.0	3.0	10,127.0	3.0
Open Land	301.0	0.1	219.7	0.1
Total	327,578.0	100.1[a]	327,578.0	100.2[2]

---

[a] Over 100.0 due to rounding.

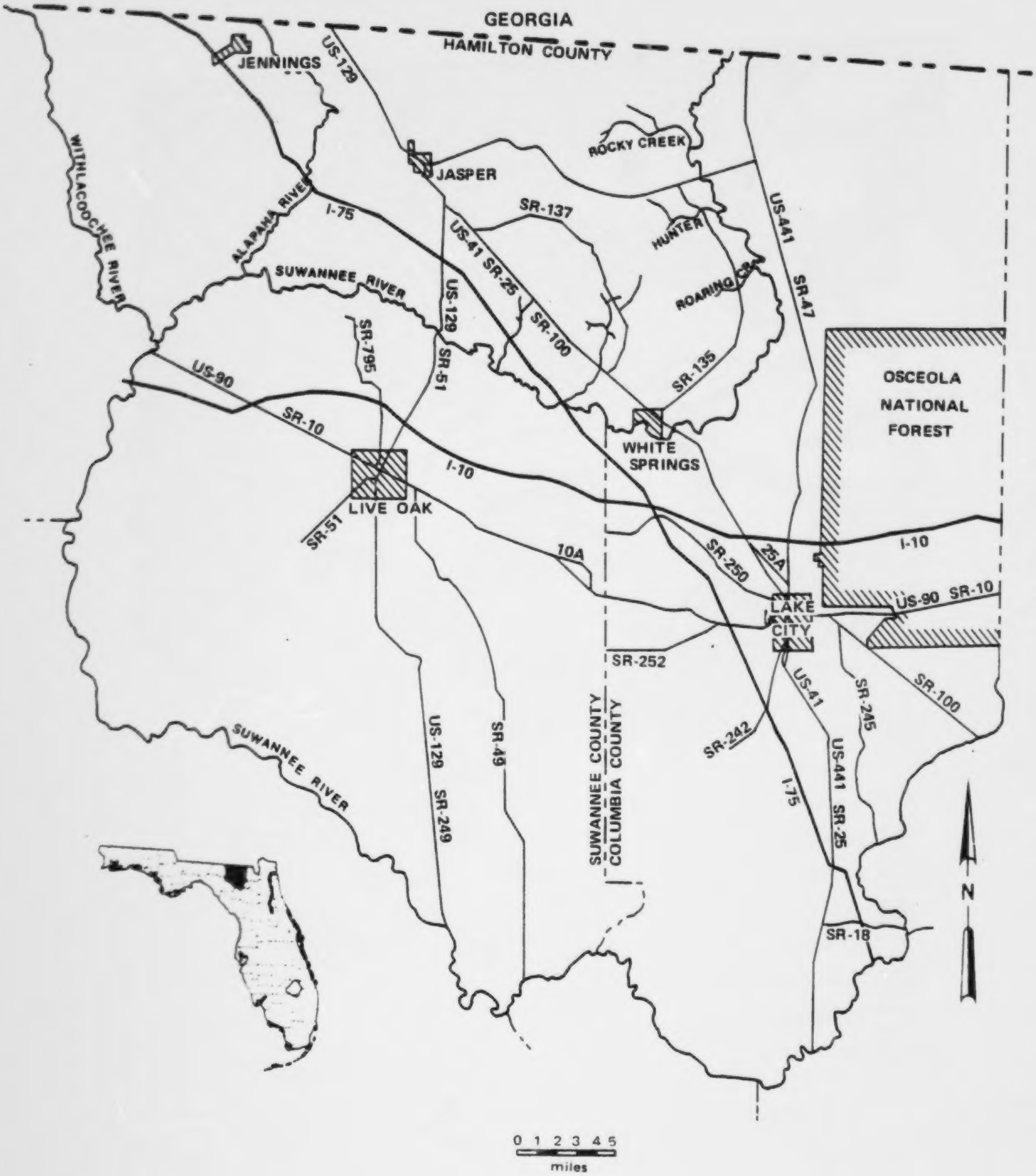
Table 2.8-56 Projected Land Use for Suwannee County in the Year 2000 (Exclusive of Live Oak).

	Existing Land Use, 1974		Projected Land Use, 2000	
Land Use	Acres	Percent of Acres	Acres	Percent of Acres
Residential	1,340.0	0.3	2,277.5	0.5
Commercial	34.0	0.1	59.5	0.1
Industrial	2,992.0	0.7	5,236.0	1.2
Institutional	4,444.0	1.0	7,777.0	1.8
Recreation	3,167.0	0.7	3,167.0	0.7
Agricultural	224,302.0	51.5	221,032.0	50.8
Forest and Natural Areas	198,810.0	45.7	195,540.0	44.9
Total	435,405.0	100.0	435,405.0	100.0


GEORGIA
JENNINGS
JASPER
HAMILTON COUNTY
MADISON COUNTY
WHITE SPRINGS
LIVE OAK
I-10
I-75
LAKE CITY
BAKER COUNTY
SUWANNEE COUNTY
COLUMBIA COUNTY
LAFAYETTE COUNTY
GILCHRIST COUNTY
ALACHUA COUNTY
UNION COUNTY
N
FOREST
AGRICULTURE
RECREATIONAL
COMMERCIAL
INDUSTRIAL
RESIDENTIAL
AIRPORTS
INCORPORATED AREAS
EXTRACTIVE
WETLANDS
miles

LAND USE IN THE THREE COUNTIES

FIGURE 2.8-1


GEORGIA
HAMILTON COUNTY
JENNINGS
US-129
WITHLACOOCHEE RIVER
ALAPAHA RIVER
JASPER
ROCKY CREEK
SR-137
I-75
US-41 SR-25
HUNTER
US-441
SR-47
SUWANNEE RIVER
US-129
SR-795
ROARING CR.
SR-100
SR-51
SR-135
OSCEOLA
NATIONAL
FOREST
US-90
SR-10
WHITE
SPRINGS
I-10
LIVE OAK
SR-51
10A
SR-250
25A
I-10
LAKE
CITY
US-90
SR-10
SR-252
US-41
SR-245
SR-100
SR-242
US-129
SR-249
SR-49
SUWANNEE COUNTY
COLUMBIA COUNTY
I-75
US-441
SR-25
SUWANNEE RIVER
SR-18
N
0 1 2 3 4 5
miles

HIGHWAY SYSTEM SERVING THE IMPACT AREA

FIGURE 2.8-2

2.9 RADIOLOGICAL

Radiation and radioactive materials occur everywhere in nature. Both existed long before man unlocked the secrets of the atom and entered the nuclear age. These naturally occurring radiations and radioactive materials can be altered and disturbed by man's technology. Almost any activity of man causes some alteration of either the quality or quantity of this natural radiation environment. The potential impact of any technologically enhanced radiation can only be understood if the existing radiological condition is clearly defined and understood.

The site has both active mines and a chemical plant and thus the true baseline may be lost. However, nearby unaltered sites do exist and these will be considered. Secondly, the current state of the environment can lead to indications as to any impact already effected. Lastly, since the west central Florida phosphate area has been extensively studies, it can serve as a point of reference for the impact expected for this north Florida site.

Items to be covered include uranium associated with the phosphate, the uranium series including radium-226 and radon-222, radon progeny, terrestrial gamma radiation, subsurface profiles of radioactivity, radium-226 in surface waters, and radium-226 in groundwaters.

The following subsections will attempt to describe the background condition of the natural radiation environment in the absence of the proposed chemical plant-mining facilities and one chemical plant are existing. The only radionuclides having potential significant impact are those of the uranium-238 decay series. The discussion will center upon the natural and disturbed condition of these radionuclides.

2.9.1 RADIONUCLIDES IN PHOSPHATE DEPOSITS

Phosphate deposits are found all over the globe in rocks ranging in age from very young (less than 10,000 years old) to over 600 million years old. For perspective, U-238 has a half life of 4,500 million years. Phosphate rock was first discovered in Florida just prior to 1880 in Alachua County. This particular deposit consisted of low grade phosphatic limestones and marls. Consequently, after only three years of mining, the region was abandoned in favor of the higher quality phosphate deposits that had since been discovered in west central Florida.

Little consideration was given to the deposits outside of those in central Florida until the early 1950's. At that time the United States Geological Survey was studying the occurrence of uranium in phosphorite and discovered radioactive anomalies immediately south of Ocala, Florida. Subsequent exploratory drilling resulted in several investigations into various aspects of the occurrence of these deposits.

Economically attractive phosphate deposits were not discovered in Hamilton County, Florida until 1964. Mining of these minerals was begun in 1965. In contrast, mining operations in the west central Florida, Bone Valley district, have been continuous since 1888. Consequently, a great deal more study has been undertaken for the Bone Valley phosphates and associated radioactivity than those of north Florida.

2.9.1.1 Origin of Phosphate Deposits and Associated Uranium

Apatite is by far the most common mineral of the phosphate group. Its general chemical formula may be written as $CA_5(PO_4)_3(F,Cl,OH)$. Apatite deposits are widespread along a line extending from the North Carolina coast down into west central Florida. The phosphate content of these deposits varies greatly along this belt. Four economically attractive accumulations occur at approximately equal intervals along the line. These are located in North Carolina, South Carolina, northern Florida and west central Florida.

Although the original formations from which these apatite deposits were derived have been obscured by extreme reworking, many similarities between them indicate a common origin. All of the most concentrated deposits seem to be of the same age, middle Miocene (approximately 20 to 25 million years old). These deposits were reworked many times, often resulting in their present-day appearance in strata younger than middle Miocene. For example, the apatite pebble deposits of central Florida occur in the Bone Valley Formation which is judged to be lower Pliocene in age (12 to 17 million years old), while the sand-sized deposits of northern Florida occur principally in the Hawthorn Formation of middle to upper Miocene age (18 to 25 million years old). All of the major accumulations occur as pebble and sand-sized particles deposited as sediment in conjunction with geologically similar environments containing clays, quartz sands and organic materials.

In order to understand the concentration of uranium, it is important to first understand the formation of the apatites. Many theories for the formation of apatites in Florida have been presented in the literature. Although they vary considerably in detail, most hypotheses recognize the association of organic matter with the phosphate deposits. It is generally agreed that apatite is deposited in areas of oceanic upwelling. During the middle Miocene, the regional geologic relationships of the southeastern United States were such that the required upwelling was occurring along the coast from North Carolina to Florida. The upwelling was caused by the meeting of the cold, southward flowing Labrador current and the warm, northerly Gulf Stream. This process has been termed "dynamic upwelling". The interaction between these currents produced turbulent mixing of the cold, nutrient laden Labrador waters with the warm Gulf Stream. This environment, being geochemically conducive to the precipitation of phosphate from the sea water, produced the primary apatite deposits. Once deposited, the apatite underwent extreme reworking due to the repeated rise and fall of sea level that occurred during later ages associated with glaciation of larger areas of the earth. By this mechanism the deposits were locally concentrated in areas of topographic depression. The reworking processes also caused chemical alterations resulting in secondary phosphate minerals which are generally more concentrated than the primary apatites from which they were derived. Later, subaerial weathering and groundwater action caused alteration and substitution in the sedimentary apatite. The extent to which these subsequent alterations occurred was governed by the thickness of sediments overlying the phosphates and the characteristics of the materials co-deposited with the apatites. Local variations in these factors are probably responsible for the variation seen in the physical and chemical characteristics of phosphate deposits in the southeastern United States.

Primary apatite contains only trace amounts of uranium, generally on the order of a few thousands or hundredths of one percent. However, most other natural materials contain at most a few parts per million and normally only one or two parts per billion. Thus, apatite serves as a natural concentrator of uranium. Sedimentary apatite typically contains from 0.005 to 0.02 percent uranium. When submitted to extensive marine reworking the uranium content of these apatites may be increased to as much as 0.1 percent. Therefore, the association of uranium with Florida phosphate deposits is to be expected.

Two theories have been advanced to explain the origin of uranium in phosphorite. One of these concludes that the uranium is post-depositionally emplaced in the apatite through the action of acidic ground waters percolating down through the phosphate zone. The other theory, and the one most generally accepted, states that the uranium if of marine origin and precipitated from the ocean water contemporaneously with the apatite. If the apatite is allowed to remain in contact with the sea water or is later reworked in a marine environment, it may become further enriched in uranium. Due to similar atomic sizes, the uranium atoms substitute for the calcium atoms in the crystal structure of apatite. Supportive evidence for this theory is found in the generally observed increase of uranium content with higher P_2O_5 percentages in the phosphate ore. Once emplaced in the apatite mineral structure, the uranium may be redistributed through the action of acidic groundwaters percolating down through the strata. This process explains the large variations in uranium content that is observed within the same and among different deposits. It is apparent that the uranium content of phosphorite can be explained only in the context of the complete geological history of the deposit.

2.9.1.2 Uranium-Phosphate Chemistry and Mineralogy

A specific study interrelating the chemistry and mineralogy with the radioactive species of the northern Florida Hawthorn formation was undertaken by Gunning in 1976 (Gunning 1976). The study consisted of an examination of profiles from the Suwannee River Mine and the Swift Creek Mine. Samples were analyzed for silicon, aluminum, phosphorous, and calcium by X-ray fluorescence. Mineralogical analysis was performed by X-ray diffraction. Uranium and thorium measurements were made by NaI gamma-ray spectrometry.

Table 2.9-1 shows the chemical composition versus depth. The P_2O_5 results clearly identify the contact zone between the phosphorite (matrix) and the overlying strata. The average P_2O_5 content in the section from the Suwannee River Mine is 2.5 percent in the overburden and 16 percent in the matrix. The section from the Swift Creek Mine contains an average of 1.6 percent P_2O_5 in the overburden and 20 percent in the matrix.

The overburden apparently consists of greater than 80 percent sand with minor amounts of phosphate minerals and clays. The occurrence above the matrix of an aluminum phosphate zone (leached zone) joined by the modification of the phosphorite unit by "leaching, secondary precipitation and replacement" (Altshuler 1955) cannot be conclusively substantiated in these particular profiles.

The mineralogical analyses on the two mine profiles is given in Table 2.9-2. The minerals found in the two profiles show many of the changes expected from the general descriptions found in the literature for west central Florida. However, a number of inconsistent departures do exist in this data, further emphasizing the distinct difference in weathering and leach zone formation between the north and west central Florida deposits. From the mineralogy analysis, the leached zone in the Suwannee River Mine profile would be represented by the 3-foot and 4-foot depths and in the Swift Creek Mine profile by the 5-foot through 12-foot samples. This zone would be recognized by the presence of crandellite and wavellite and the absence of apatite. However, the formation of the zone and the additional variation make it significantly different from the typical Bone Valley deposits. The delineation of the leached zone by the presence of uranium is also interesting.

Cathcart (1955) and Altshuler, et al. (1963) have published detailed papers on the west central Florida land pebble deposits of the Bone Valley Formation and its relationship to uranium. Cathcart found the highest uranium concentrations to be at the base of the leached zone and associated with the calcium phosphate minerals (Cathcart 1955). Uranium in the matrix was found to occur almost exclusively with apatite. Altshuler drew similar conclusions. Uraniferous strata corresponded with calcium phosphates, and a subzone of basal enrichment in uranium appeared in the leached zone (Altshuler 1956).

Measurements for both uranium and thorium were obtained for ten of the 14 samples used in this study (Table 2.9-3). The values for thorium appear to have a somewhat inverse relationship to those for uranium. In the upper part of the sections, uranium is present in relatively small quantities and thorium has its highest values. In the middle of the sections uranium enrichment corresponds to the lowest thorium measurements. These elements have undergone changes through processes of weathering in the overburden and leached zone.

The least weathered strata available is found in the lower matrix--Suwannee River Mine (9' and 15' depths) and Swift Creek Mine samples (19' and 37' depths). Within these samples the values for uranium averages 22 ppm. The average P_2O_5 content for the matrix in both sections combined is 18 percent. In the matrix of the west central Florida pebble phosphate district the average P_2O_5 content of the matrix is just below 20 percent, and the average uranium content is about 80 ppm in unweathered sections (Cathcart 1956). These figures indicate that the Hawthorn Formation in northern Florida contains, on the average, less uranium than phosphatic sediments in west central Florida.

The uranium enriched zone at the top of the matrix apparently moves down through the section as weathering proceeds.

> "Uranium is liberated during the leaching of apatite pebbles in the upper part of the zone. It is kept soluble in the descending acid water, probably as complexed uranyl and uranous ions, and it is secondarily enriched in the porous partly leached apatite pebbles at the base of the zone by structural replacement of calcium (Altshuler 1955)."

According to this interpretation, the highest concentration of uranium should occur just below the leached zone or at the top of the matrix. In fact, uranium in the Swift Creek Mine at 17' depth (values for the 14' depth was not available), and Suwannee River Mine at the 6' depths, which both lie at the top of the matrix, exhibit the two highest concentrations in this study--115 ppm and 89 ppm, respectively. On this basis, one might extend the leached zone into these top matrix samples although no aluminum phosphate minerals appear here. In west central Florida the average values for uranium in the enriched zone at the base of the leached zone was 120 ppm (Cathcart 1955). Again the values for uranium concentration in northern Hawthorn Formation are slightly less than those for west central Florida.

2.9.1.3 Thorium

The values for thorium, in general, are lower than for uranium by a factor of 10. Interestingly enough, the earth's crustal average for U/Th is 0.26. That is, thorium is usually more abundant than uranium. In the northeastern Florida beach sands, the average thorium concentration is 11 ppm and the average uranium concentration is 4.0 ppm (Mahdavi 1963). The Suwannee River Mine at the 3' depth is the only sample analyzed which contains uranium and thorium in concentrations similar to those averages for beach sands stated above. The secondary crandallite which appears in this sample is most likely a product of evaporation. Gunning proposes that it would be valid to conclude that this sample (Suwannee River Mine depth 3') is from a true sandy overburden, and that all other samples analyzed that lie above the matrix are remnants of weathered matrix, and are, therefore, part of a leached zone enriched in uranium.

In the other samples thorium concentrations average 6.8 ppm in the leached zone and 2.8 ppm in the samples below the top matrix samples which show uranium enrichment. Thorium is esentially insoluble relative to uranium, and occurs in high concentrations in extensively reworked beach sands (as stated above). In the samples above the matrix, the higher thorium concentrations than is found in the lower matrix may be due to the presence of more sand with which it is associated. A plot of thorium vs. percent silica (Figure 2.9-1) shows a trend that suggests a correlation between the two.

2.9.1.4 North Florida Uranium

The phosphate mineralogies of the deposits of both north Florida and west central Florida are essentially the same. The physical characteristics of the apatite particles are different in that the Bone Valley apatites of west central Florida tend to be of pebble size and thus larger than the sand-sized ore contained in the Hawthorn Formation deposits of Hamilton County. Although argument still persists, the Hawthorn deposits are probably slightly older (on the order of a few million years) than those of the Bone Valley, both being deposited within the interval of 15 to 25 million years ago.

The environments of deposition for the two deposits probably involved similar processes differing only in scale, the more vigorous processes accounting for the larger sized apatite particles in the Bone Valley deposits. One possibly significant difference between these two areas involves what is known as the leached zone. The upper portion of the Bone Valley Formation has been leached, altered to aluminum phosphates, and enriched in uranium through groundwater processes. This zone is widespread, though discontinuous, throughout the west central Florida phosphate district and averages 6 to 7 feet in thickness. Overall uranium content in this aluminum phosphate zone is approximately 50 percent higher than the phosphate ore section underlying it. A geologically similar zone does appear in northern Florida deposits; however, it seems to be more aerally limited and thinner than that of the Bone Valley Formation. This dissimilarity may be a function of differences in thickness, permeability and composition of the overlying sediments between the two regions, thereby altering the effect of groundwater processes on the underlying phosphate zones.

Sedimentary apatite deposits are considered to be the result of many interrelated and complex geological processes, the details of which are not perfectly understood. Even less is known about the observed affinity of uranium for the apatite minerals. Consequently, great care must be exercised in drawing conclusions concerning the expected uranium content of any particular phosphate deposit based upon this limited knowledge.

Concentrations of uranium and thorium seem to be independent of each other except perhaps where heavy enrichment of uranium occurs. Thorium appears to be concentrated in the more quartz-rich strata; however more investigation into this theory would be beneficial. Uranium behaves as predicted from similar studies in west central Florida, however, it occurs in lower concentrations in the corresponding overburden, aluminum phosphate and matrix units. The total uranium concentration in the north Florida pebble phosphate district appears to be lower than in west central Florida.

There are two significant points to be considered in estimating the relative amount of uranium in the northern Florida deposits. First, the similarity in the geologic histories prior to and during final deposition of the two apatite deposits argue toward a similar overall uranium to phosphate ratio. Secondly, there exists a possible difference in distribution of the uranium within each deposit due to the seemingly more prevalent leached zone in the Bone Valley Formation. This second point is important in that the location of the uranium within the deposit will have to be considered with relation to processing of the ore and the final distribution of the phosphate products, by-products and wastes.

In summary, based upon limited knowledge the tentative conclusion may be drawn that the northern Florida phosphate deposits should not differ appreciably from those of west central Florida in overall uranium to phosphate ratio. There is, however, one important factor related to the distribution of uranium within the phosphate matrix and leached zone which may be important to mining operations and the subsequent land reclamation. In the Hamilton County deposits, the leached zone is considerably thinner than the leached zone observed in Polk County. Because of this, there may be less radioactive material in the overburden and, therefore, a higher probability that the leached zone material will not be concentrated near the ground surface during land reclamation.

The occurrence of radionuclides in tailings, slimes and gypsum from phosphate rock mining and chemical operations still remains a factor, however; and if the tailing or slimes are used for land reclamation, ambient levels of radioactivity could be elevated. The waste gypsum must be considered carefully, for the radium in the uranium decay series will be concentrated in gypsum because of the chemical similarity of Ca^{++} and Ra^{++}. Uranium is concentrated in the phosphoric acid and, although it may be a lost resource, it will not be considered as a waste or evaluated as to its potential environmental impact.

2.9.2 THE URANIUM SERIES

In order to understand the hazard posed by disturbing the location and both the physical and chemical state of the natural radioactivity present in the phosphate a clear understanding of the complexities of the uranium decay series is required. The following discussion will define terms and subgroups of the series in relationship to the proposed facility.

Uranium has two naturally occurring isotopes, uranium-238 and uranium-235. The uranium-238 series has a longer half life and at present accounts for 99.3 percent of the naturally occurring uranium. The uranium-235 and its decay series does not present a significant hazard, but the uranium-235 is a potential resource for nuclear power production. The uranium-235 series will not be further considered.

Thorium-232 represents the parent radionuclide of the other naturally occurring series. Radium-228 is a member of this series that should be mentioned here. In the continental United States, the ratio of thorium to uranium concentrations in surficial strata is somewhat greater than 4, that is, thorium is more prevalent (Oakley 1972). The document for the drinking water standards for radium (EPA, August 1975) reviewed the relationship between radium-226 and radium-228. It was determined that when all factors such as thorium/uranium ratios, equilibrium states, half-lifes, transport times, etc. were considered, the expected radium-228 /radium-226 ratio would not exceed unity in ground waters. Therefore, the standard (EPA 1976) incorporated a screening level for radium-226 less than or equal to 3 pCi/l for a standard of 5 pCi/l total radium. If the $\leq$3 pCi/l of radium-226 level is satisfied, then the total (radium-226 and radium-228) is assumed to be less than 5 pCi/l.

At the site of the proposed plant, the average thorium concentration is lower than the national average. Using similar assumptions to the basis of the drinking water standards, the radium-228/radium-226 ratio is predicted to be less than 0.02. Therefore, radium-228 concentrations would normally be undetectable at average groundwater levels (≈2 pCi/l) of radium-226. Radium-228 will not be considered in any future sections.

2.9.2.1 Uranium Equilibrium

In the uranium-238 series, decay proceeds usually through 13 intermediate radionuclides, called daughters, to a stable endpoint of the element lead with a mass number of 206. The radionuclides in the series are diagrammed in Figure 2.9-2. Vertical displacements in Figure 2.9-2 involve alpha emissions (release of positively charged particles containing two neutrons and two protons).

Diagonal displacements represent beta emissions (release high-energy electrons from the nucleus and thus a neutron is lost and a proton is gained). Some of the particulate emissions are accompanied by gamma emissions (release of high-energy electromagnetic radiation).

The rate at which a radioactive nuclide will disintegrate (disintegrations per second) is related to the number of radioactive atoms present and the half-life (the time it takes for the activity (dps) of a particular radionuclide to be reduced by a factor of two; two half-lifes will reduce the activity by a factor of 4; three half-lifes will reduce the activity by a factor of 8, and so on...). A given number of disintegrations per second has been given a unit: 3.7 x 10^{10} dps equals one Curie. Most of the discussions in this report will deal with a much smaller unit: the picocurie (pCi) or 10^{-12} curies.

For any particular daughter radionuclide in the series, there is a rate of production via decay of its immediate parent and a rate of loss via decay into the next daughter. The nature of the mathematics is such that a condition of equilibrium is achieved if the entire series is contained in a "sealed" location over a long period of time. In other words, a geological sample containing 100 pCi of U-238 may also contain 100 pCi of Th-234, 100 pCi of Pa-234, 100 pCi of U-234, and so on, through 100 pCi of Po-210. Habaski suggests that in sedimentary phosphates uranium exists in radioactive equilibrium with all its decay products (Habaski 1966).

Equilibrium is maintained only if the materials are undisturbed. Natural phenomena may produce a disturbance. A notable possibility is the potential transport of the noble gas radon-222 away from the location to its radium-226 parent. Depending on the mineralogy and the physical nature of the deposit, radon-222 may diffuse to the void space and begin diffusive transport to areas of lower concentration, usually upward toward the atmosphere. In this case, the overall equilibrium of the series may be disturbed if the radon escapes the general area of its production.

Differential dissolution of specific materials by groundwaters would also disturb the equilibrium; however since uranium and radium are normally present in rocks and soil at equilibrium activity levels, the solubility of each and the intermediates must all be extremely low. The presence of both uranium and radium in high concentrations and in equilibrium within the leached zone, when present, is a strong indication of the insolubility of these radionuclides and their intermediates. Even in the more unique locations in the United States radium-226 in deep well water may reach only 100 pCi/l. For radium-226 the specific activity is approximately unity (1 curie = 1 gram) and this concentration of 100 pCi/l becomes 10^{-10} gram/l or 0.0001 ppb.

The manufacture of phosphoric acid and other fertilizer products is of interest in this chemical plant project.

As they occur naturally, the radionuclides present in the phosphate matrix and leached zone have presented virtually no problem. The soil overlying the layers is normally 20 to 60 feet thick (Figure 2.9-3).

This soil provides sufficient shielding to reduce gamma radiation exposure at the ground surface to background levels normally experienced throughout the United States.

Radon-222 transport out of the matrix to the surface is minimal and essentially none from the matrix reaches the surface. Radium-226 has evidently remained within the matrix for geologic ages in equilibrium with uranium-238 and has not contaminated the shallow and deep aquifers with any chemically significant amounts.

Mining, however, produces a considerable disturbance of this natural condition leading to many new transport pathways that must be addressed. Mining may cause the higher activity leached zone material and small quantities of the matrix to be redeposited near the ground surface upon reclamation. The physical character of the material containing the activity is changed as a new geohydrology is established. The by-product materials from the processing of the phosphate matrix contain various amounts of uranium and its decay series.

In some cases, mined land is reclaimed with by-product materials from the processing of the phosphate matrix. These materials contain approximately one-third of the uranium originally present in the matrix. Physical processing does not appreciably alter the equilibrium from uranium-238 through radium-226 (Gunning 1977). However, Roessler et al. suggests a 10-25 percent enrichment of radium-226 relative to uranium-238 in the beneficiation process (Roessler, December, 1977).

In phosphoric acid production (which requires phosphate rock as a raw material after mining and beneficiation), the radioactive equilibrium is severely disrupted with uranium-238 appearing primarily in the phosphoric acid and radium-226 precipitated with the gypsum (both calcium and radium are divalent cations). The fertilizer concentrations of each radionuclide materials reflect the mix and processing of the ingredients.

Chemical separation of the eight elements in the uranium-238 series would lead to a temporary disequilibrium. However, in a reasonably short time period several sections will again approach equilibrium. Figure 2.9-4 indicates the new uranium equilibrium. It should be noted that because the major gamma emitters are the daughters of radon-222, the external level of radiation of separated uranium is limited and the percent contribution by the gammas from associated uranium-235 greatly increases.

2.9.2.2 Radium

Figure 2.9-5 illustrates the equilibrium established from chemically separated radium. This behavior of this series is important to the hazard evaluation and comprises the primary basis for the detection of radium-226 either by quantification of radon-222 alpha decays or of lead-214 and bismuth-214 gamma emissions.

Radium-226 is of particular interest in regard to human exposure. Radium is chemically similar to calcium and tends to be incorporated biologically in the same way as calcium. Radium replacement is clearly demonstrated by the high radium-226 concentrations found in the gypsum ($CaSO_4 \cdot 2H_2O$). Radium-226 may be ingested through drinking water in which the material has been dissolved. A less probable pathway is via uptake into foods grown on soils containing radium-226.

On July 9, 1976 the Envrionmental Protection Agency promulgated regulations for radioactivity in drinking water (EPA 1976). The maximum contaminant levels for radium-226 and radium-228 (a decay series radionuclide of the thorium-232 chain) cannot exceed 5 pCi/l in community drinking water. Interior guidelines for National Pollutant Discharge Elimination System (NPDES) permits for fertilizer and phospate manufacturing was issued by EPA in 1975. The effluent limitation of 9 pCi/l total radium-226 was recommended.

Radium, like uranium, is ubitiqous in nature and is found in almost every environmental media. The average daily intake per person in the USA has been estimated to be 1.4 pCi (United Nations 1972).

2.9.2.3 Radon Progeny

The radium-226 decay scheme equilibrium, is highly dependent upon the mobility of the radon-222, an inert gas. The last four radionuclides in the decay scheme shown in Figure 2.9-5 are known as radon progeny (or daughters of radon). In the neutral state, most of the radon-222 produced in a phosphate matrix would not escape the media. Mining, beneficiation and chemical processing not only alters the location and chemical condition of the radium-226 but may increase the probability that radon-222 will be able to diffuse from the site at which it was created. Figure 2.9-6 diagrams this potential transport. The ability for the radon to move from the mineral or media into the void space of the soil is defined by a term called emanating power, E, usually expressed as a percent. The general expression defining the term for a closed unit volume would be:

$$E = \frac{\text{pCi/gram radon-222 in the void space}}{\text{pCi/gram radon-222 in the total sample}} \cdot 100$$

Obviously, the concentration of radon-222 in the total sample should be equal to the concentration of radium-226.

2.9.2.3.1 Working Levels -- Any concentration gradient for radon will induce molecular diffusion of this "emanated" radon to the surface of the soil. The rate of movement through the soil-air interface will be in units of pCi/m^2 sec and is termed "radon flux". This parameter is considered an important screening unit for testing reclaimed lands. A standard radon flux is expected from the EPA in the near future.

Very few radon flux measurements have been made in north Florida. Roessler et al. (Roessler 1976) report one flux measurement in Hamilton County on unaltered lands at 0.1 pCi/m^{2}sec. Six sites in Alachua County resulted in an average radon flux of 1.1 pCi/m^2 sec and nine virgin sites in Polk County produced an average radon flux of 0.3 pCi/m^2 sec.

The airborne radon-222, whether in the open air, near industrial sources, or inside homes, will decay and an approach to equilibrium between the next four daughters (polonium-218, lead-214, bismuth-214, and polonium-214) will start. These four radionuclides are known as the radon progeny.

Airborne radon progeny concentrations are customarily expressed in "Working Level" units. This unit was devised in an attempt to provide a meaningful expression to describe airborne radon progeny concentrations regardless of the condition of equilibrium among radon and its various short-lived daughters. One Working Level (WL) is defined as any combination of radon progeny in one liter of air whose ultimate decay through polonium-214 will deliver 1.3×10^5 MeV of alpha energy. The unit for integrated exposure is known as the Working Level Month (WLM). Inhalation of air containing a radon progeny concentration of one WL for 170 working hours results in an exposure of one WLM.

Due to nature and/or man-made ventilation conditions, radon daughters equilibrium is usually never achieved or maintained for any length of time. This condition certainly holds true for measurements taken in the phoshpate industry.

The important pathway to exposure of man is via the inhalation of radon daughters. These radon progeny may deposit in and irradiate parts of the lung, particularly the basement membranes of the bronchial airways (EPA 1975). The expected response to this irradiation is an increase in lung cancers (National Academy of Sciences 1972).

Indoor radon progeny measurements (WL) made in Polk County residences precipitated much of the present concern in Florida over technologically enhanced natural radioactivity (EPA 1975). No measurements of Working Levels in structures near the proposed site could be found in the literature. Roessler et al. (Roessler 1978) reported a mean of 0.0006 WL for six homes in Alachua County. The State (FDHRS 1978) has taken a value of 0.004 WL for background in a recent proposed guideline for remedial action in central Florida homes. Roessler et al. (Roessler, February 1977) reports a value of 0.002 WL for homes in Polk County on virgin Lands.

2.9.2.3.2 Long-Lived Daughters

There is one other way to view the uranium decay series. The radionuclides uranium-238, uranium-234, thorium-230, radium-226 and polonium-210 are all long-lived radionuclides that could become airborne in dusty operations or other mechanisms. Individual airborne radionuclides are measured in terms of concentration in air, for example pCi/m^3. The airborne radioacitvity limit for each radionuclide is expressed in terms of a maximum permissible concentration (MPCa), i.e., that concentration which, under continous exposure, would just result in a maximum permissible dose to an appropriate critical organ. Every radionuclide has a unique associated MPC value. However, determining specific concentrations of individual alpha emitters in a mixed population is most difficult and gross alpha screening at an appropriate level is an accepted alternative. Measurements of individual long-lived radionuclides in airborne particulates could not be found in the literature for north Florida sites.

2.9.3 BACKGROUND RADIATION

This section will review the various background radiation sources with particular emphasis on comparing the proposed site to USA averages and west central Florida levels. The items to be reviewed include: terrestrial gamma radiation, subsurface radioactivity, levels of radioactive contaminants in surface and well waters, as well as special baseline conditions. These latter parameters are particularly related to reclamation and occupational exposure in the plant: they include radon flux from the soil surface, radon concentration, radon progeny concentration (or Working Levels), and long-lived uranium series radionuclides.

Table 2.9-4 summarizes the estimated average background dose to United States citizens from natural radiations and compares it to estimates from other man-made sources.

Cosmic radiation from outer space is primarily absorbed in the upper atmosphere, however, secondary radiations are present at ground level. Altitude is the single most important cause of variation with Florida (near sea level) having a lower than average rate, about 29 mrem/yr while the higher elevations of Colorado exceed 100 mrem/year. (NCRP 1975).

Measurements with survey instruments are usually in terms of μR/hr. For comparisons in later sections note that 29 mrem/year would be approximately 3.3 μR/hour.

2.9.3.1 External Terrestrial Gamma

In the continental United States, the external terrestrial radiation arises primarily from gamma ray emissions of the thorium series, the uranium series and potassium-40. The latter is a naturally occurring isotope of potassium with a long half-life. In typical circumstances the thorium series and the potassium-40 combine to account for over 70 percent of the external exposure. However, in Florida the contribution to the external terrestrial radiation complex by the uranium series probably accounts for a higher percentage in virgin areas and all of the man-enhanced increases.

The overall average level in Florida is lower than the national average given in Table 2.9-4. Literature values show a considerable range for Florida, probably due to inclusion of different land types including disturbed lands: Golden (1968) - 26 mR/yr (3 μR/hr); Levin, et al. (1968) - 17 mR/yr (1.9 μR/hr); State of Florida (DHRS 1977); - 16 mR/yr (1.8 μR/hr); and Oakley (1975); 12 mR/yr (1.4 μR/hr). The total average external background radiation level (cosmic + terrestrial) in Florida is expected to be between 6.3 and 4.7 μR/hr (55 and 41 mR/hr).

2.9.3.2 Gamma Radiation On-Site

In early 1976, a field survey for external gamma radiation levels existing on the Occidental Chemical Company property was conducted (Sholtes & Koogler Environmental Consultants 1976). Virgin land (including lands to be mined in the next three years), lands being mined, and reclaimed lands were included in the survey. All measurements were made at a distance of one meter above the ground using a W.B. Johnson GSM-5 survey meter with a GST scintillation probe.*

Figure 2.9-7 shows the areas to be included in a three year mining plan Occidental Chemical Company has perceived in early January of 1976. The land sections are pieces of approximately 17 sections of their property. The survey attempted to obtain data from each mining year, each mine and section. However, the wetness of some areas and inaccessibility, even for a four-wheel drive vehicle, precluded some distribution of data.

Table 2.9-5 summarizes the gamma survey data. The original report (Sholtes & Koogler Environmental Consultants 1976) shows the specific locations of individual readings. Most of the data points were in virgin areas.

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* Initially calibrated by exposure, at a series of measured distances, to a National Bureau of Standards (NBS) certified radium-226 needle (a point source). Later cross calibrations with field conditions (plane source) and the Reuter-Stokes, RS111 pressurized ion chamber of the Florida Department of Health and Rehabilitative Services yielded an intercept of about 3.3 μR/hr to be added to the W.B. Johnson readings. The published data (Sholtes & Koogler Environmental Consultants 1976) were therefore low by this increment. Discussions here utilize the updated readings.

The three year mining plan for the Swift Creek area includes three separate plots. The easternmost plot includes Section 25, 26 and 36 of Township 1 North, Range 14 East. The first ten entries in Table 2.9-5 summarize the data obtained in this area. Most of the data is in virgin land and the average gamma level is about 5 μR/hr. In some cases it was evident that pebble or other materials have been used for roadway construction. The second entry in the table shows a reading of 9.7 μR/hr. This reading was taken in the centerline of a road that cuts across the southwestern corner of Section 25.

The entries 11 through 18 in Table 2.9-5 are for the areas around dragline No. 4. Again, the virgin background gamma radiation level approaches 6 μR/hr. Four exceptions to this are noted, an 8.1 μR/hr over a railway bed, a 6.4 μR/hr up on the dike of a slime pond, 8.9 μR/hr over a pipeline, and 14.5 μR/hr over a small pebble pile probably used for a resource for road construction. One should note that the several sections that were cleared of trees and underbrush had readings near the average of unmined areas.

The Suwannee River mine areas followed approximately the same pattern. Again, much of the area, especially Sections 30, 31 and 32 of Township 1 North, Range 16 East was inaccessible due to lack of roads, even for four-wheel drive vehicles. Some of the area has been disturbed with timber clearing, canals, and pipelines. The average reading for Section 31, with dragline No. 2, shows approximately 6.6 μR/hr average with a high value of 9.5 μR/hr. Centerlines of roads in any location were also high, ranging from 8.1 to 27.1 μR/hr. One reading upon the sand tailings gave a value of 12.3 μR/hr.

In summary, the average value for unmined areas in this general vicinity is on the order of 5 μR/hr. This would convert to 44 mR/yr. Roessler (February, 1977) has reported typical background gamma radiations for north Florida and west central Florida. (See Table 2.9-6). Values reported by Roessler et al. were taken from relatively small tracts such as building lots, and from larger tracks of undeveloped lands. The limited number of measurements preclude hard conclusions, but the west central Florida data appears to be slightly elevated over that of north Florida.

2.9.4 SUBSURFACE RADIOACTIVITY

Since the origin of the uranium in the deposits is similar to the phosphate, it should be evident that the concentration of uranium should follow the concentrations of phosphate: a low concentration in the overburden and a high concentration in the matrix. The actual distribution is slightly different. In both north Florida and west central Florida mining regions, the radioactivity is low at the surface, increases gradually and then more rapidly with depth and is most concentrated in or just above the matrix. Figure 2.9-8 represents a composite generalized profile of radium content with depth in undisturbed phosphate lands as constructed by Roessler, (February 1977) from various profiles. Uranium and radium are in general equilibrium. If present, the leached zone is usually marked by high radioactivity.

The distribution of radioactivity within the matrix is variable. For a west central Florida site with distinct leached zone see Figure 2.9-9. The radium-226 generally tends to decrease somewhat with depth of the matrix; however Figure 2.9-9 also indicates the wide variation one may obtain by small samples of the matrix. Samples of composite matrix can be much lower than individual fractions.

Since a major fraction of the gamma radiation level in Florida is related to the uranium series, gamma logs of wells should also reflect this general profile. Figure 2.9-10, a gamma well log, can be compared to Figure 2.9-9 constructed from uranium and radium analysis of 23 samples. The location of the gamma log within the west central Florida land pebble district is unknown, yet the similarity is striking.

A second gamma well log from west central Florida is shown in Figure 2.9-11 (Ardaman & Associates, 1977). Here the depth has been extended to 1,000 feet. The lower characteristics have been often ignored by others and yet these features play an important role in the consideration of the possibility of contamination of groundwaters. The existence of rather enormous quantities of radioactivity between the mined fraction and the deep aquifers has not been adequately addressed in the literature.

Consider the gamma log of the well shown in Figure 2.9-11, which is typical of the west central Florida area. The activity (also relative radium concentration) increases nearly linearly with depth to approximately 35 feet where the rate sharply increases as does the phosphate level (Guyton 1976) and then falls gradually to around the 100-foot mark. The mineable matrix lies between the 35-foot and the 90-foot levels. Since the origin of the matrix is known to be linked to the Hawthorn formation, the entire Hawthorn strata, here approximately 300 feet thick, would be expected to also contain uranium and its daughters because of its geologic history. The gamma log dramatically illustrates this fact. The activity begins to increase again below the matrix and reaches a peak at about the 200-foot level. It then decreases beyond the 350 to 400 foot level and falls off slowly with depth. These increases and decreases generally correlate well with increases and decreases in phosphate content (Guyton 1976).

This distribution of activity with depth is also reflected in the radium profiles obtained for the site. The DRI statement for this mine (Ardaman & Associates 1977) contains a composite of eight profiles near this well. The analysis of core samples average the concentration versus depth and therefore, the observed changes with depth are not as vivid as with the gamma logs but certainly the same vertical pattern exists. No cores were analyzed beyond 100 feet for radium content, but the direct correlation of the radium profiles with the shape of the various gamma logs is conclusive.

By a technique of graphical integration of this activity curve (Figure 2.9-11), it is possible to relate the fraction of activity occurring between any depths. The numbers shown in Figure 2.9-11 are the percent of area beneath the curve (relative activity) occurring at 100-foot intervals from the surface to 1000 feet using the total area under the curve (total activity) as 100 percent.

By this method it is readily apparent that the overburden and mineable matrix represents only 8.1 percent of the total activity in the 1000-foot column and the activity in the material derived from the Hawthorn, i.e., the matrix, represents only about 13 percent of the total activity within the Hawthorn formation. Note that the primary aquifer lies below the Hawthorn formation.

The Department of the Interior has prepared an impact statement on potential mining in the Osceola National Forest located just south and east of this proposed site (Miller 1977). This study incorporated data from a large number of wells, most of which were gamma logged. Although considerable variation existed from well to well, a general pattern emerges from a review of the numerous gamma logs in the Osceola study. Many indicate:

a) a rapid rise in activity to the near-matrix depth,

b) the high activity of the matrix,

c) a brief decrease in activity,

d) sporadic high levels of activity throughout the Hawthorn formation, and

e) a precipitous drop in activity as the aquifer is traversed.

Figure 2.9-12 illustrates this general trend. There is a hint of two areas of high activity in Figure 2.9-12 and it is repeated even more dramatically in many of the other logs from the Osceola study (Figures 2.9-13 and 2.9-14 show this bi-layer phenomena. The near-surface layer of high activity is apparently associated with the leached zone (if present), the phosphate matrix, and the top of the Hawthorn. The deeper layer of high activity is apparently associated with the D and E units of the lower Hawthorn. Of 22 gamma logs reviewed, the activity always fell to low values when the depths corresponding to the lower aquifer were attained.

In order to relate the findings concerning the gamma logs in west central Florida and the Osceola area to the present study, gamma logs were requested for three wells on the Occidental property. The logging results are shown in Figures 2.9-15, 16, and 17. The bi-layer phenomena observed in the Osceola logs is present, however, the lower layer is much less pronounced. The sharp drop of activity at the beginning of the aquifer is present.

From the driller's logs of wells SC-1-C and SC-2-C, it appears that the highest activity occurs at or just above the beginning of the phosphate containing strata. The description of the strata did not exceed 50' in well SC-3-E and thus the location of the aquifer is unknown. The second high activity layer at SC-3 is nearly twice that depth of the other two locations.

Although this topic will be discussed in more detail in Section 3.5, it should be noted here that the monitor well sets draw water from locations indicating high gamma log activities. The relationship between the uranium series and the gamma emissions has been reviewed in previous sections. Because of existence of higher radium contents in strata from which water is drawn for monitoring purpose, it may be exceedingly difficult to determine the existence of radium-226 seepage from other locations.

Table 2.9-7 summarizes several sources of data on the vertical distribution of radioactivity on the Occidental Chemical Company property. In most cases the highest activity is found just above the matrix. The distribution of activity from analysis of core data appears to follow the pattern of the gamma log response previously discussed. No cores from below the matrix were analyzed directly for specific radionuclides.

Table 2.9-8 compares the subsurface radioactivity data of Groome (1977) for north Florida against west central Florida by sample type. Her analyses suggest that the radium-226 concentration in north Florida top soil (normally the first six to 12 inches) averages 0.5 pCi/g while west central Florida top soil averages 1.3 pCi/g. These values are comparable to the 0.7 pCi/g average radium-226 concentration given by Eisenbud for 23 specimens of rock and soil in the USA (Eisenbud 1973).

The weighted overburden for the two sites in Table 2.9-8 could not be considered as having different radium-226 concentrations; however, the upper range in west central Florida is about three times that of the north Florida site.

Groome's data on the matrix at the two sites reinforce the known difference between the two locations. Both the averages and upper ranges of individual samples indicate a matrix concentration of radium-226 in north Florida that is about 20 percent of the west central Florida values.

The Roessler data (February 1977) suggest that both regions have radium in approximate equilibrium with the parent uranium.

2.9.5 SURFACE WATER QUALITY

Radium-226 in surface waters of the USA is generally low (between 0.03 and 1.0 pCi/l) except for certain locations such as mineral springs, waters with high solids content, and waters that drain fertilized farming areas. This distribution can be seen in Table 2.9-9. The latter entries are specific to Florida and the last three entries are taken from the impact statement on the potential mining in the Osceola National Forest.

These streams are about two to three miles southeast of the proposed chemical plant and should represent a lower limit of the natural surface waters.

2.9.6 GROUNDWATER QUALITY

Concern for the potential of groundwater contamination with radium-226 or other contaminants due to phosphate mining operations has been expressed in a number of reports (Sholtes & Koogler Environmental Consultants 1976; Battelle 1973; Data Graphics, Inc. 1971; Guimond 1975; and Irwin et al. 1976). The most extensive review of the literature and data analysis for west central Florida has been undertaken by Kaufmann and Bliss (1977). They statistically analyzed available radium data from 1966 and from 1973-1976 in three strata: upper water table, Upper Floridan aquifer, and Lower Floridan aquifer. Each water resource was considered in three geographic areas of west central Florida: mined (mineralized) areas, unmined mineralized areas, and non-mineralized areas. The basic data summary is shown in Table 2.9-10. All data for a particular set was found to be distributed log normally. Therefore, geometric means are considered for comparison of sets.

The authors (Kaufmann and Bliss, 1977) preface the report with the following statement:

> "The reader should be aware that two rather diverse viewpoints surround this study and report. Some have considered the data base too limited to conclude that no widespread or significant contamination has occurred or is occurring. Therefore, extensive additional studies are essential. Others, particularly

> industry, consider the data and interpretation herein as confirmation that contamination has not occurred, that present practices and data collection requirements are adequate and that more study and monitoring would be inefficient." (Kaufmann 1977)

The geometric mean radium-226 in the water table aquifer was 0.17 pCi/l in the unmined mineralized areas and 0.55 pCi/l in the mined areas. The mined area appears to have a higher level, but statistical tests indicate no significant difference between the 0.17 and 0.55. No data were summarized for the non-mineralized area.

When the Upper and Lower Floridan aquifer data were considered, mined areas and nonmined areas were all approximately equal and both portions of the aquifer were similar. Statistical tests on the comparison of non-mineralized data versus the mining areas showed that the Floridan had higher concentrations of radium-226 in the non-mineralized areas. The Floridan aquifer showed significanly higher levels than the water table aquifer.

Kaufmann and Bliss did not consider gamma logs of deep wells. As discussed previously, gamma logs to 1,000 feet show considerable radioactivity in the Hawthorn formation overlaying the Floridan aquifer. The gamma logs strongly suggest that the Lower Hawthorn itself may be a source of radium-226 in the Floridan aquifer.

Gamma logs of the non-mineralized areas may explain the observation that the radium in the Floridan aquifer in non-mineralized areas was either equal to or higher than both mined and nonmined mineralized areas (Kaufmann and Bliss, 1977). Uranium, and therefore radium would logically be associated with the entire Hawthorn.

Another finding by Kaufmann and Bliss (1977) was the presence of three separate populations of radium-226 in the Lower Floridan Aquifer. These groups had geometric means of 0.7, 3 and 10 pCi/l, respectively. They state that: "elevated levels of radium-226 in the Lower Floridan aquifer can be due to a number of natural factors unrelated to phosphate mineralization or waste management in the phosphate industry." They mention increased solubility of radium in groundwater enriched by chloride and the salt water intrusion due to the pumping from the Lower Floridan aquifer.

The Swift DRI (Ardaman & Associates 1977) supports this theory. Packer testing of a 2,000 foot well yielded 0.8 pCi/l at one increment of depth, higher activity over larger increments (1.7 to 2.6 pci/l) and 12.7 pCi/l at one small increment. The radium and water quality were directly related. The depth increment pumping the 12.7 pCi/l radium-226 concentration had over 50,000 ppm Na^+. The lowest radium (0.8 pCi/l) was associated with water having 18 ppm Na^+.

Kaufmann and Bliss found radium-226 in wells of Sarasota County to be two orders of magnitude greater in the water table aquifer and almost one order of magnitude greater in the Floridan aquifer. Dissolution or radium-226 from the Hawthorn formation which tends to outcrop in western Sarasota County may account for the first finding. This raises the question of the value of monitoring wells into the Hawthorn at any location. Interaction with salt water intrusion may account for the second finding.

Studies of radioactivity in groundwaters of northern Florida are limited. Two will be reviewed here -- a study of radium-226 in groundwaters in Alachua County (Palmer 1977) and the Osceola Mining Impact Study (Miller 1977).

Table 2.9-11 summarizes Palmer's data. The wells are grouped by use rather than depth. The average gross alpha level for 20 wells was 8.1 pCi/l. Palmer did not average the eight wells with values less than his detection limit. Twenty-nine out of 38 wells had radium-226 levels greater than his detection limit of about 0.7 pCi/l. The average radium-226 concentration in the wells showing results greater than the lower limit of dection was 2.6 pCi/l. Both gross alpha and radium-226 concentrations would be somewhat lower if "less than" values were averaged as "equal to" values. The gross alpha to radium-226 ratio was about three.

Producing wells serving larger populations were softened. Three samples of raw water for Gainesville yielded radium-226 levels of 1.5, 3.0 and 0.7 pCi/l while one sample of delivered water (special analysis procedure) indicated 0.08 pCi/l radium-226 (Palmer 1977).

The Osceola study (Miller 1977) grouped wells by the geological strata from which water was drawn. See Table 2.9-12. Note that the highest average for either measure of radioactivity was located in the last unit of the Hawthorn formation. The data for the first four units appear to follow the pattern observed in the gamma logs. The source of the radioactivity in the Floridan aquifer may be the Lower Hawthorn unit, since gamma logs indicate little activity in the solid media of the aquifer. These levels compare favorably to those observed by Kaufmann and Bliss, even though averages in Table 2.9-10 are compared to the geometric means (lower than the arithmetic average) for the central Florida data. The gross alpha to radium-226 ratio for these data range from about 6 to 10. Sample preparation procedures may account for the higher ratio.

2.9.7 SUMMARY

Baseline conditions at the proposed site are as follows:

Gamma Radiation - Approximately 5 μR/hr over unaltered lands: typical Florida background ranges from 4.7 to 6.3 μR/hr.

Subsurface Radioactivity - Gamma logs show highest levels at the top of the matrix, some continued activity through the Hawthorn with secondary high spikes.

- Uranium and radium measurements confirm highest activities either just above or in top of matrix.

Matrix Radioactivity - Radium approximately 8 pCi/g or 20 percent of that observed in west central Florida.

Radon Flux at Soil Surface - Extremely limited data indicating 0.1 pCi/m^2 sec. Data on analtered land in Polk County averages 0.3 pCi/m^2 sec.

Radon Progeny in Structures - No measurements available, however, the lower subsurface radioactivity at Occidental should yield lower WL than observed in west central Florida.

Surface Water Radioactivity - Radium-226 between less than 0.02 to 2.9 and normally less than 1 pCi/l.

Groundwater Radioactivity - Radium-226 betwee less than 0.1 to 5 and normally less than 2 pCi/l, concentration appears to be related to depth and, therefore, radium in the immediate media. Poor water quality, especially high Na$^+$ (or Cl$^-$) may enhance radium content.

Table 2.9-1 Chemical Analyses

Description		$\%SiO_2$	$\%P_2O_5$	$\%CaO$	$\%Al_2O_3$	Total	CaO/P_2O_5
Suwannee River Mine							
3'	Overburden	85	0.68	0.53	13.0	99	0.8
4'	Overburden	84	4.3	1.8	9.2	99	0.4
6'	Matrix	48	17.0	25.0	4.2	94	1.4
9'	Matrix	59	14.0	20.0	2.5	95	1.4
15'	Matrix	55	16.0	22.0	1.9	95	1.4
50'	Bed Clay	74	4.6	11.0	8.4	98	2.3
Swift Creek Mine							
2-1/2'	Overburden	86	0.57	0.31	12.0	99	0.54
5'	Overburden	85	1.6	0.82	12.0	99	0.52
7-1/2'	Overburden	82	2.0	1.0	14.0	99	0.51
12'	Overburden	89	2.4	1.5	6.7	99	0.62
14'	Matrix	42	20.0	27.0	3.8	93	1.3
17'	Matrix	32	24.0	34.0	2.0	91	1.4
19'	Matrix	56	17.0	20.0	2.4	95	1.2
37'	Matrix	50	18.0	25.0	2.0	94	1.4

Source: Gunning 1976

Table 2.9-2 Mineralogical Analyses of Mine Profiles in North Florida (Gunning, 1976)

Description		Quartz	Apatite	Feldspars	Wavel-lite	Crandal-lite	Kaoli-lite	Montmoril-lonite	Attapul-gite
Suwannee River Mine									
3'	Overburden	x				x	x		
4'	Overburden	x		x	x	x	x	x	
6'	Matrix	x	x	x			x	x	
9'	Matrix	x	x	x			x		
15'	Matrix	x	x	x			x	x	
50'	Bed Clay	x							x
Swift Creek Mine									
2-1/2'	Overburden	x					x		
5'	Overburden	x				x	x		
7-1/2'	Overburden	x				x	x		
12'	Overburden	x		x	x		x	x	
14'	Matrix	x	x	x			x	x	
17'	Matrix	x	x	x			x	x	
19'	Matrix	x	x	x				x	
37'	Matrix	x	x	x					x

Table 2.9-3 Uranium and Thorium Content of Mine Profiles in North Florida

Description Suwannee River Mine	U (ppm)	Th (ppm)	U/Th
3' Overburden	4.3	14.0	0.31
4' Overburden	24.0	6.1	3.9
6' Enriched Zone	89.0	0.79	110.0
9' Matrix	33.0	3.6	9.3
15' Matrix	22.0	2.5	8.8
Swift Creek Mine			
5' Overburden	15.0	8.0	1.9
10' Overburden	8.6	6.3	1.4
17' Enriched Zone	115.0	0.0	---
19' Matrix	20.0	2.5	8.1
37' Matrix	14.0	2.4	5.9

Source: Gunning 1976

Table 2.9-4 Average Doses from Radiation in the United States in 1970 (NA 5 72)

Source	Average Dose, mrem/year		
Environmental			
Natural			
Cosmic Rays	44		
Terrestrial Radiation			
External	40		
Internal	18		
Total	102 →	102	
Global Fallout		4	
Nuclear Power		0.003	
Total		106 →	106
Medical			
Diagnostic		72	
Radiopharmaceuticals		1	
Total		73 →	73
Miscellaneous			3
Grand Total			182

Table 2.9-5 Gamma Survey of Occidental Chemical Company Property, January 30 and February 14, 1976.

Quadrangle	Township, Range	Section	Mine	Drag-Line	& Mining Year	Description of Land	No. Meas.	Mean Range μR/hr
Genoa-Hillcoat	1 N, 14 E	25	Swift Creek	#5	Begin '78	Unmined	10	5.0 (4.7-5.3)
Genoa-Hillcoat	1 N, 14 E	25	Swift Creek	#5	Begin '78	Centerline Rd.	1	9.7
Genoa-Hillcoat	1 N, 14 E	26	Swift Creek	#5	End '78	Unmined	10	4.9 (4.7-5.3)
Genoa-Hillcoat	1 N, 14 E	26	-----------	--	North of #5, '78	Unmined	6	4.6 (4.4-5.0)
Hillcoat	1 N, 14 E	35	-----------	--	East of #5, '77	Unmined	4	5.2 (5.0-5.3)
Hillcoat	1 N, 14 E	35	Swift Creek	#5	Mid '77	Unmined	2	4.7 (4.7-4.7)
Hillcoat	1 N, 14 E	35	Swift Creek	#5	Mid '76	Unmined	2	5.1 (4.4-5.8)
Genoa-Hillcoat	1 N, 14 E	36	Swift Creek	#5	Begin '77	Unmined	8	5.0 (4.7-5.3)
Genoa-Hillcoat	1 N, 14 E	36	Swift Creek	#5	Mid '76	Unmined	4	4.8 (4.4-3.3)
Genoa-Hillcoat	1 S, 14 E	1	-----------	--	South of #5, '76	Railroad	1	8.1
Genoa	1 N, 15 E	32	Swift Creek	#4	Begin '76	Cleared	2	5.2 (5.0-5.3)
Genoa	1 N, 15 E	32	Swift Creek	#4	Begin '76	Centerline Rd.	1	15.2

Table 2.9-5 continued
Page two

Quadrangle	Township, Range	Section	Mine	Drag-Line	& Mining Year	Description of Land	No. Meas.	Mean Range μR/hr
Genoa	1 S, 15 E	5	-----------	--	West of #5, '76	Unmined	1	5.0
Genoa	1 S, 15 E	5	Swift Creek	#4	End '76	Cleared	2	4.8 (4.7-5.0)
Genoa	1 S, 15 E	5	Swift Creek	#4	End '76	Unmined	4	4.7 (4.7-5.0)
Genoa	1 S, 15 E	5	Swift Creek	#4	1977	Unmined	7	4.7 (4.4-5.0)
Genoa	1 S, 15 E	5	Swift Creek	#4	Begin '78	Unmined	6	4.9 (4.7-5.3)
Genoa	1 N, 15 E	31	-----------	--	--------	Pond Dike	1	6.4
Genoa	1 S, 15 E	6	-----------	--	--------	Pipeline	1	8.9
Genoa	1 S, 15 E	6	Swift Creek	#4	Begin '77	Unmined	8	4.9 (4.7-5.0)
Genoa	1 S, 15 E	6	-----------	--	East of #1 '77	Unmined	2	5.0
Genoa	1 S, 15 E	6	Swift Creek	#1	End '77	Unmined	3	4.9 (4.7-5.0)
Genoa	1 S, 15 E	6	Swift Creek	#1	Begin '78	Unmined	1	5.0
Genoa	1 S, 15 E	8	Swift Creek	#1	End '78	Unmined	2	4.4
Genoa	1 S, 15 E	8	-----------	--	Between #1 & #4 1978	Unmined	7	4.7 (4.4-5.0)

Table 2.9-5 continued
Page Three

Quadrangle	Township, Range	Section	Mine	Drag-Line	& Mining Year	Description of Land	No. Meas.	Mean Range µR/hr
Genoa	1 S, 15 E	8	-----------	--	Between #1 & #4 1978	Small Pebble Pile	1	14.5
Genoa	1 S, 15 E	8	Swift Creek	#4	End '78	Unmined	4	5.0
Genoa	1 S, 15 E	8	Swift Creek	#4	End '78	Centerline Rd.	1	17.3
Genoa	1 S, 15 E	10	-----------	--	West of #1 '76	Unmined	6	5.0 (4.7-5.3)
Genoa	1 S, 15 E	10	Swift Creek	#1	Begin '77	Unmined	3	4.9 (4.7-5.0)
Genoa	1 S, 15 E	10	Swift Creek	#1	1976	Unmined	2	5.2
Genoa-Benton	1 N, 16 E	31	Suwannee River	#2	'77 & '78	Disturbed	5	6.6 (5.0-9.5)
Genoa-Benton	1 N, 16 E	31	--------	--	North of #2 '77	Centerline Rd.	1	8.1
Genoa-Benton	1 N, 16 E	31	--------	--	South of #1 '77	Sand Tailings	1	12.3
Benton	1 S, 16 E	5	Suwannee River	#2	Begin '77	Unmined	3	4.8 (4.7-5.0)
Benton	1 S, 16 E	5	Suwannee River	#2	1976	Unmined	4	4.9 (4.7-5.0)

Table 2.9-5 Continued
Page four

Quadrangle	Township, Range	Section	Mine	Drag-Line	& Mining Year	Description of Land	No. Meas.	Mean Range µR/hr
Benton	1 S, 16 E	4	---------	--	East of #1 '76	Unmined	2	4.7
Benton	1 S, 16 E	8	---------	--	South of #1 '76	Unmined	3	4.5 (4.4-4.7)
Benton	1 S, 16 E	9	---------	--	South of #1 '76	Unmined	3	4.6 (4.4-5.0)
Genoa-Benton	1 S, 16 E	7	---------	--	North of #1 '78	Unmined	3	4.8 (4.4-5.3)
Genoa-Benton	1 S, 16 E	18	Suwannee River	#1	1978	Unmined	10	4.9 (4.4-5.3)
Genoa-Benton	1 S, 16 E	19	Suwannee River	#1	End '78	Unmined	2	4.7
Genoa	1 S, 15 E	12	Suwannee River	#3	1976	Some Disturbed	8	5.3 (4.4-7.8)
Genoa	1 S, 15 E	12	Suwannee River	#3	1976	Centerline Rd.	1	27.1
Genoa	1 S, 15 E	13	Suwannee River	#3	1976	Road & Pipeline	1	24.3
Genoa	1 S, 15 E	13	Suwannee River	#3	Begin '76	Unmined	4	5.1 (4.4-5.5)

Table 2.9-5 Continued
Page Five

Quadrangle	Township, Range	Section	Mine	Drag-Line	& Mining Year	Description of Land	No. Meas.	Mean Range µR/hr
Genoa	1 S, 15 E	24	Suwannee River	#3	1977	Unmined	6	4.9 (4.7-5.3)
Genoa	1 S, 15 E	24	Suwannee River	#3	1977	Centerline Rd.	1	21.0

Table 2.9-6 Mean Gamma Field Averages and Ranges by Land Type in the North and Central Florida Mining Regions.

	OCCIDENTAL CHEMICAL COMPANY			WEST CENTRAL FLORIDA		
Land Type	N	Average Mean Gamma Level (μR/hr)	Range of Means Levels (μR/hr)	N	Average Mean Gamma Level (μR/hr)	Range of Mean Levels (μR/hr)
Virgin	1	4.0	--	8	4.7	4.3-5.0
Overburden	1	7.9	--	3	8.3	7.1-10.3
Tailings	1	9.8	--	6	10.3	7.4-12.8
Debris	--	---	--	4	18.4	16.1-21.0
Capped Clays	--	---	--	2	23.0	21.7-24.3

After Roessler, 1977.

Table 2.9-7 Radioactivity Profiles: Occidental Chemical Company Property

Ref.	Description	Ra-226 pCi/g	U pCi/g	U ppm	Ra/U ratio
Sh 76	Core 0-8, S1, T1S, R14E				
	17.0-17.5' overburden	1.7	3.5	7.0	0.5
	35.0-35.5' leach zone	21.0	15.46	1.4	-
	36.0-38.0' matrix	11.0	7.0	20.0	1.6
Sh 76	Core N-9, S1, T1S, R14E				
	17.0-17.5' overburden	1.5	1.7	5.0	0.9
	34.0.-35.0' leach zone	15.0	14.0	41.0	1.1
	40.0-41.0' matrix	4.5	3.7	11.0	1.2
Gu 76	Suwannee River Mine				
	3' and 4' overburden	(4.7)*	(4.7)**	14.0	N/A
	6' enriched zone	(30.0)	(30.0)	89.0	N/A
	9' and 15' matrix	(9.2)	(9.2)	28.0	N/A
Gu 76	Swift Creek Mine				
	5' and 10' overburden	(4.0)	(4.0)	12.0	N/A
	17' enriched zone	(38.0)	(38.0)	115.0	N/A
	14' and 37' matrix	(5.7)	(5.7)	17.0	N/A
Gr 77	Mine #1 (sampled 4/30/76)				
	0.0-2.0' overburden	0.78	0.7	2.1	1.11
	2.0-4.0' overburden	1.75	1.9	5.7	0.92
	4.0-7.0' overburden	10.56	8.8	26.0	1.20
	7.0-11.0' matrix	9.1	14.8	44.0	0.61
	11.0-16.0' matrix	8.21	7.2	22.0	1.14
	16.0-21.0' matrix	6.13	5.4	16.0	1.14
	21.0-23.0' matrix	6.90	6.4	19.0	1.08
	23.0'- matrix	2.56	3.9	12.0	0.66
Gr 77	Mine # 2 (Sampled 4/30/76)				
	0.0-10.0' overburden	0.57	<0.4	<1.0	-
	10.0-11.0' overburden	2.39	2.4	7.2	0.99
	11.0-16.0' overburden	2.73	3.5	10.0	0.78
	16.0-19.0' overburden	5.08	5.8	17.0	0.88
	19.0-23.0' matrix	23.52	21.0	63.0	1.12
	23.0-27.0' matrix	58.81	48.8	150.0	1.2
	27.0-29.0' matrix	7.97	7.5	22.0	1.06

* Values in parenthesis were calculated from uranium concentrations assuming equilibrium.

** Values in parenthesis were calculated from uranium concentrations using specific activity of natural U-238.

Table 2.9-8 Comparison of Radium-226 Concentrations: Occidental Chemical Property Vs. West Central Florida

Sample Type	Occidental Property		West Central Florida	
	No. of Samples	Radium-226 pCi/g	No. of Samples	Radium-226 pCi/g
Topsoil				
Average	4	0.5	4	1.3
Range		0.02-0.08		0.04-3.8
Overburden				
Average at Weighted Overburden	2*	3.6	3*	4.0
Range of Weighted Overburden		2.0-5.2		1.3-5.5
Range of Individual Samples	8	0.6-10.6	27	0.3-30.6
Matrix				
Average of Composite Samples	4	8.6	6	37.6
Range of Composite Samples		5.1-13.2		18.1-84.2
Range of Individual Samples	10	5.4-58.8	19	9.7-136

* Number given is number of profiles used in the weighted average.

Sources: After Groome, 1977, as updated by Roessler et al., 1977.

Table 2.9-9 Radium-226 in Surface Waters in the U.S.A. and Florida

Type	Location	Radium-226 pCi/l	Ref.
River Waters	Average North America	0.03	Lo 56
Mississippi River	St. Louis, Mo.	1.2-2.9	Lo 56
Great Salt Lake	Utah	5	Lo 56
Curie Spring	Boulder, Colorado	267,000	Lo 56
Ohio River	Pennsylvania	0.6	Lo 56
Surface Water Supply	Chicago, IL	0.03	Ho 63
Lithia Springs	Lithia, FL	0.68	Ir 76
Alafia River	Lithia, FL	0.06	Ir 76
Peace River	Ft. Meade	0.12	Ir 76
Proposed Four Corners Mine (7 stations, 18 samples)	Hillsborough and Manatee Counties, Florida	0.18	Mo 77
Middle Prong St. Marys River	Osceola National Forest	0.08	Mi 77
Deep Creek	Osceola National Forest	0.06	Mi 77
Robinson Creek	Osceola National Forest	0.07	Mi 77

Table 2.9-10 Summary of Radium-226 Data in Central Florida Aquifers

Area Description	Water Table		Aquifer			
			Upper Floridan		Lower Floridan	
	No.	pCi/l*	No.	pCi/l	No.	pCi/l
Unmined Mineralized	23	0.17	5	2.30	24	2.0
Mined Mineralized	12	0.55	10	1.61	6	1.96
Nonmineralized (Control)	NO DATA		3	5.1	14	1.4

Source: After Kaufman and Bliss, 1977.

* All data are geometric means of author's preferred data.

Note: Drinking water standard for total radium is 5 pCi/l.

Table 2.9-11 Summary of Radioactivity in Alachua County Groundwater[1] (Pa 77)

	Gross Alpha pCi/l			Radium-226 pCi/l		
	N[2]	$\bar{X}$	(Range) [+/N][4]	N	$\bar{X}$	(Range) [+/N]
Untreated Water Supplies[3]	8	6.8	(3.1-11.8) [3/8]	12	1.9	(0.7-7.0) [10/12]
Landfill Monitoring Wells	20	8.3	(1.0-54.4) [17/20]	26	2.8	(1.0-17.2) [19/26]
Total Ambient Groundwaters	28	8.1	(1.0-54.4) [20/28]	38	2.5	(1.7-17.2) [29/38]

---

[1] Dissolved fraction.

[2] No. of wells.

[3] Includes input to softening plants and water used directly without softening.

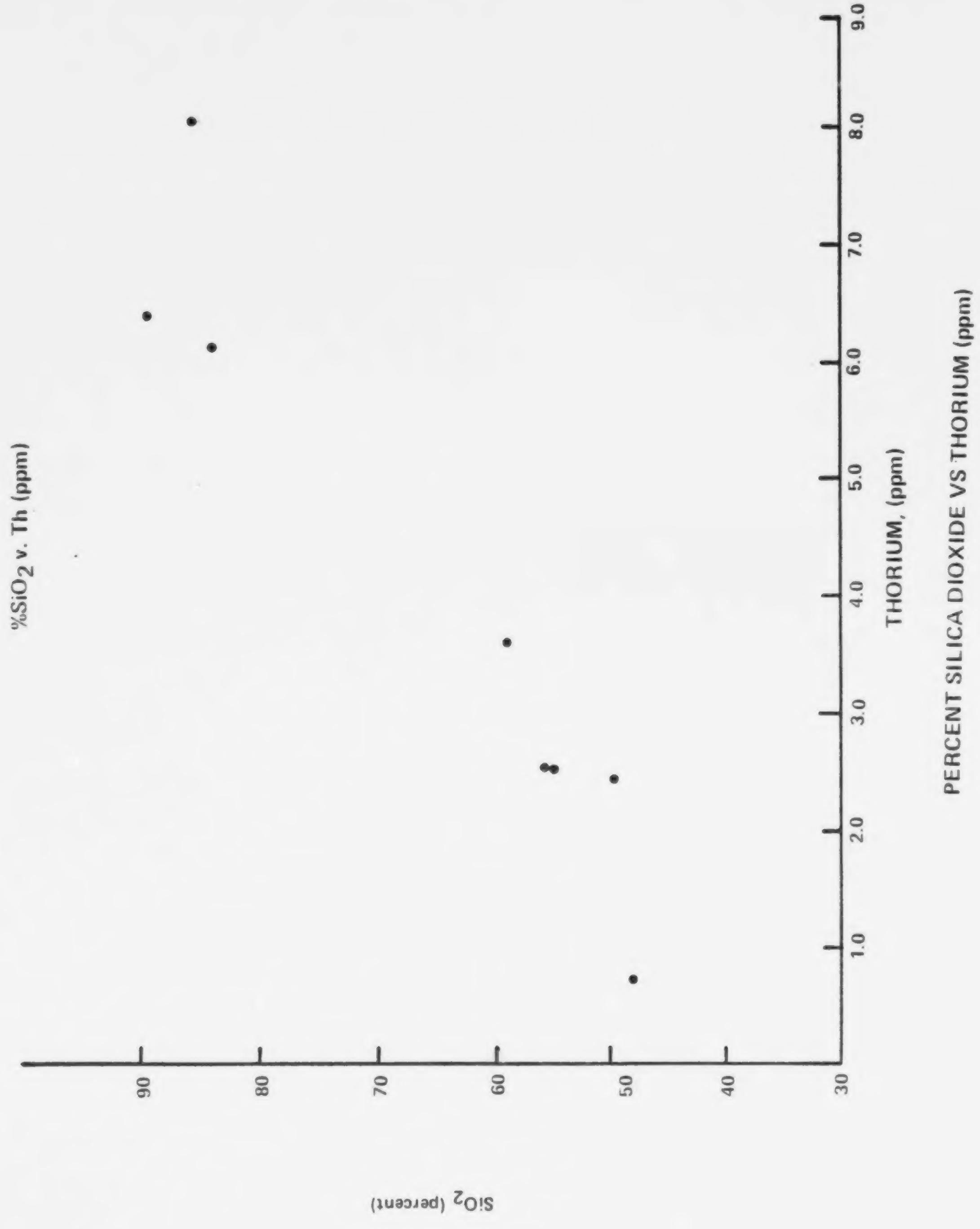
[4] Number of brackets indicate ratio of number of samples with activity greater than the lower limit of detection for the analysis to total number of samples. The numerator also designates number of samples used to compute $\bar{X}$ (mean) and range.

Table 2.9-12 Summary of Gross Alpha and Radium-226 Data from the Groundwater Study in the Osceola National Forest

Description	Radioactivity, pCi/l Gross Alpha Avg.* (Range) No.	Radium-226 Avg.* (Range) No.
Superficial Aquifer		
Post Miocene Sand Unit	1.3 (<0.8 - 2.3) 3	(<0.1 -<0.01) 2
Hawthorn Member "A"	4.4 (<0.3 - 6.4) 3	(<0.1 - 0.7) 2
Hawthorn Continuing Unit		
Member "C"	9.0 (<3.5 -23.0) 6	0.9 (0.5 - 1.1) 4
Member "E"	26.0 (-) 1	2.2 (-) 1
Floridan Aquifer	13.0 (<3.5 -43.0)10	1.8 (0.6 - 5.2) 7

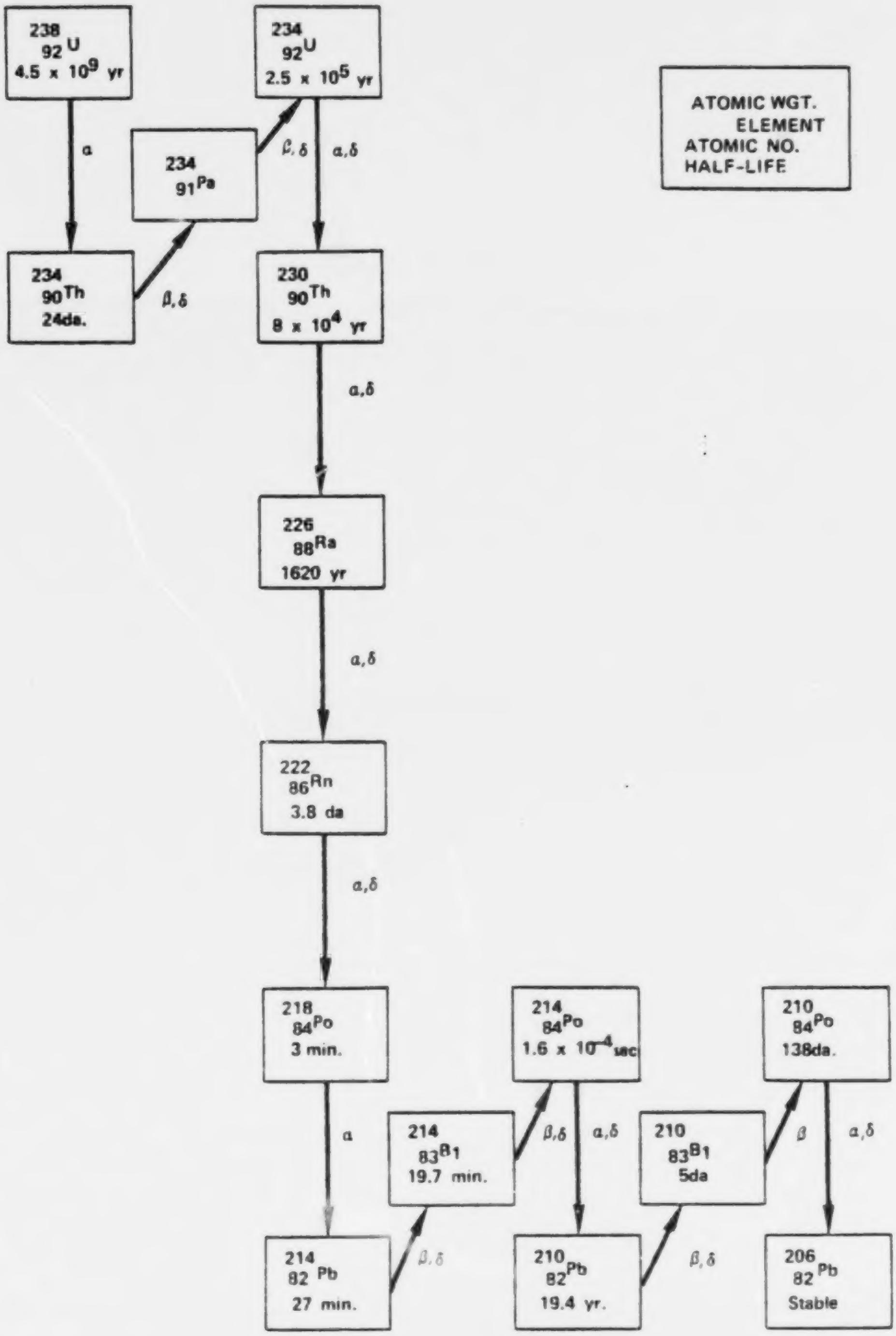
* "Less than" values averaged as "equal to" values

Source: After Miller, 1971.



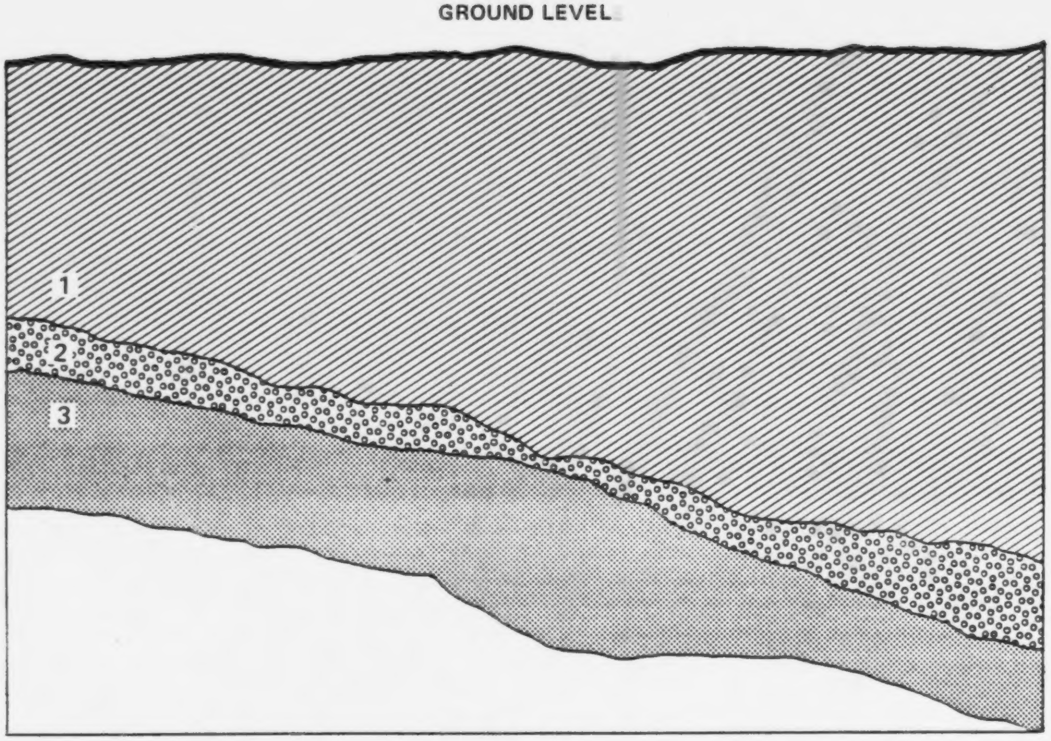
PERCENT SILICA DIOXIDE VS THORIUM (ppm)

FIGURE 2.9-1


238 92 U 4.5 x 10^9 yr
234 92 U 2.5 x 10^5 yr
ATOMIC WGT.
ELEMENT
ATOMIC NO.
HALF-LIFE
a
234 91 Pa
β, δ
a, δ
234 90 Th 24da.
β, δ
230 90 Th 8 x 10^4 yr
a, δ
226 88 Ra 1620 yr
a, δ
222 86 Rn 3.8 da
a, δ
218 84 Po 3 min.
214 84 Po 1.6 x 10^-4 sec
210 84 Po 138da.
a
214 83 Bi 19.7 min.
β, δ
a, δ
210 83 Bi 5da
β
a, δ
214 82 Pb 27 min.
β, δ
210 82 Pb 19.4 yr.
β, δ
206 82 Pb Stable

URANIUM-238 DECAY SERIES

FIGURE 2.9-2



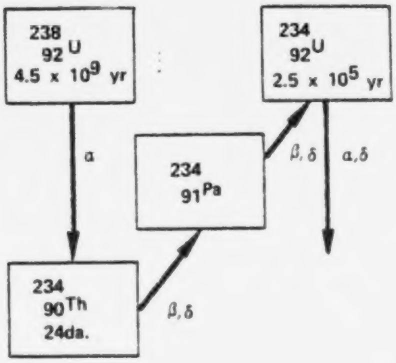
1-OVERBURDEN; 10-20 FEET THICK

2-LEACHED ZONE; 0-2 FEET THICK

3-MATRIX; 10-15 FEET THICK

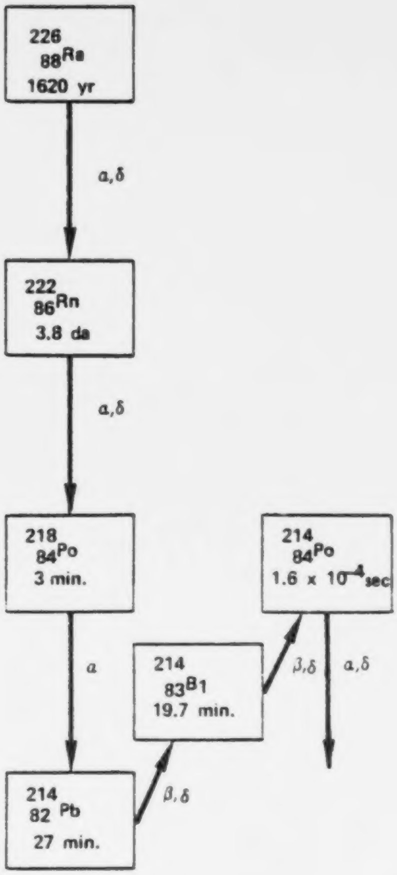
RELATIONSHIP OF OVERBURDEN TO LEACHED ZONE AND TO PHOSPHATE ROCK MATRIX HAMILTON COUNTY, FLORIDA

FIGURE 2.9-3


238
92 U
4.5 x 10^9 yr
a
234
90 Th
24da.
β, δ
234
91 Pa
β, δ
234
92 U
2.5 x 10^5 yr
a, δ

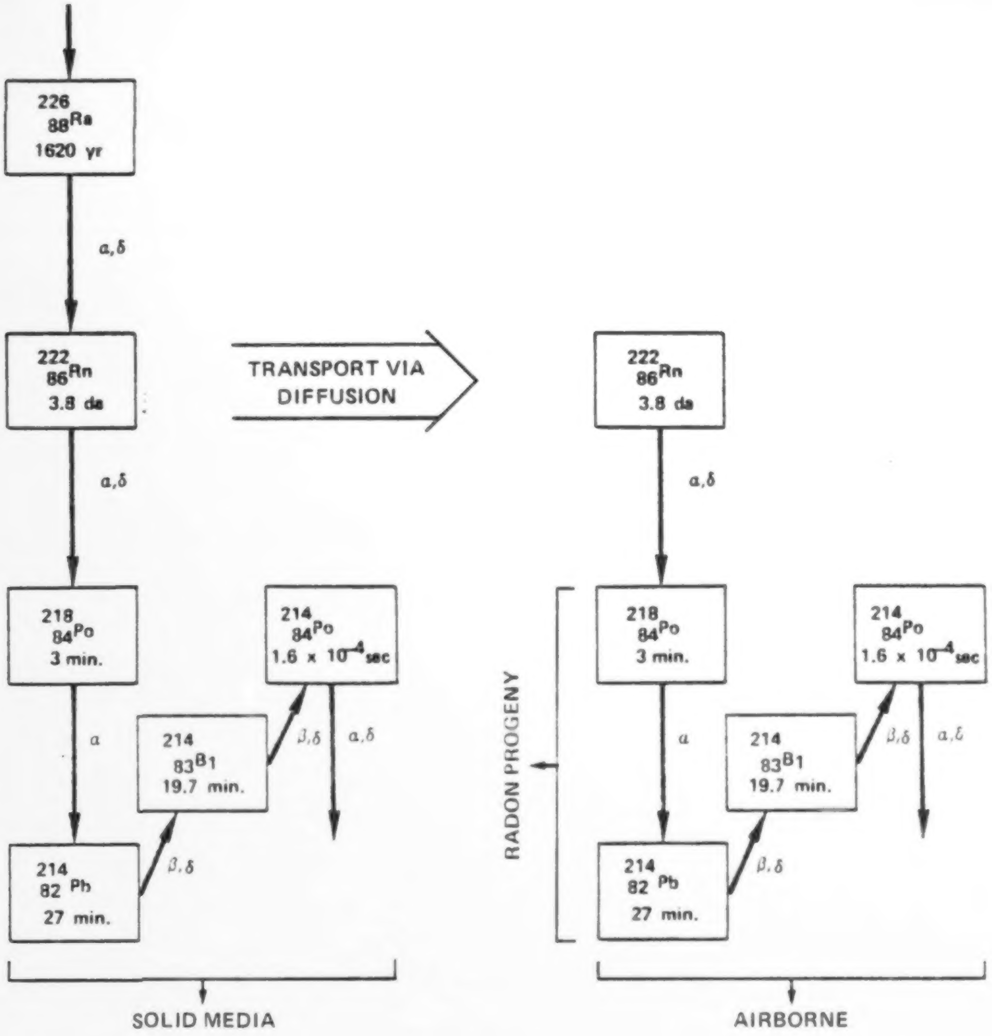
EQUILIBRIUM ESTABLISHED 120 DAYS AFTER CHEMICAL SEPARATION OF URANIUM

FIGURE 2.9-4


226
88Ra
1620 yr
a,δ
222
86Rn
3.8 da
a,δ
218
84Po
3 min.
a
214
82 Pb
27 min.
β,δ
214
83Bi
19.7 min.
β,δ
214
84Po
1.6 x 10-4 sec
a,δ

EQUILIBRIUM ESTABLISHED 20 DAYS AFTER CHEMICAL SEPARATION OF RADIUM

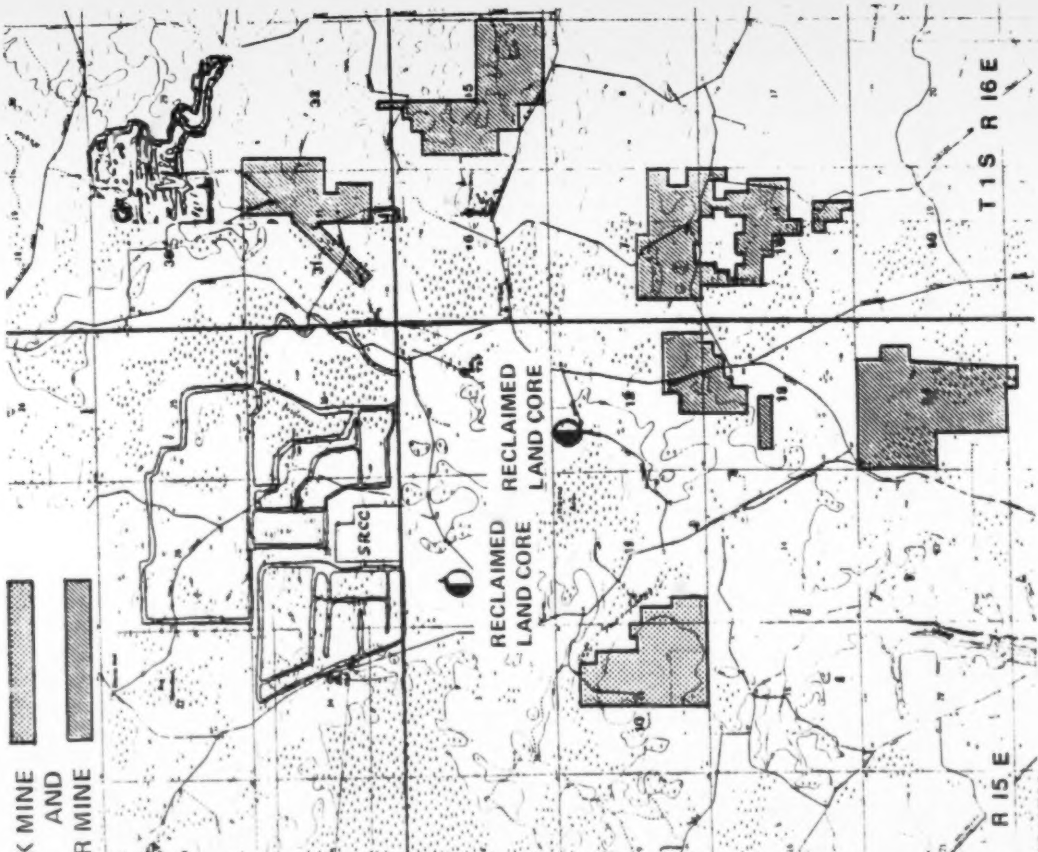
FIGURE 2.9-5



226 88 Ra 1620 yr
α,δ
222 86 Rn 3.8 da
TRANSPORT VIA DIFFUSION
222 86 Rn 3.8 da
α,δ
218 84 Po 3 min.
α
214 83 Bi 19.7 min.
β,δ
214 84 Po 1.6 x 10-4 sec
α,δ
214 82 Pb 27 min.
β,δ
RADON PROGENY
SOLID MEDIA
AIRBORNE

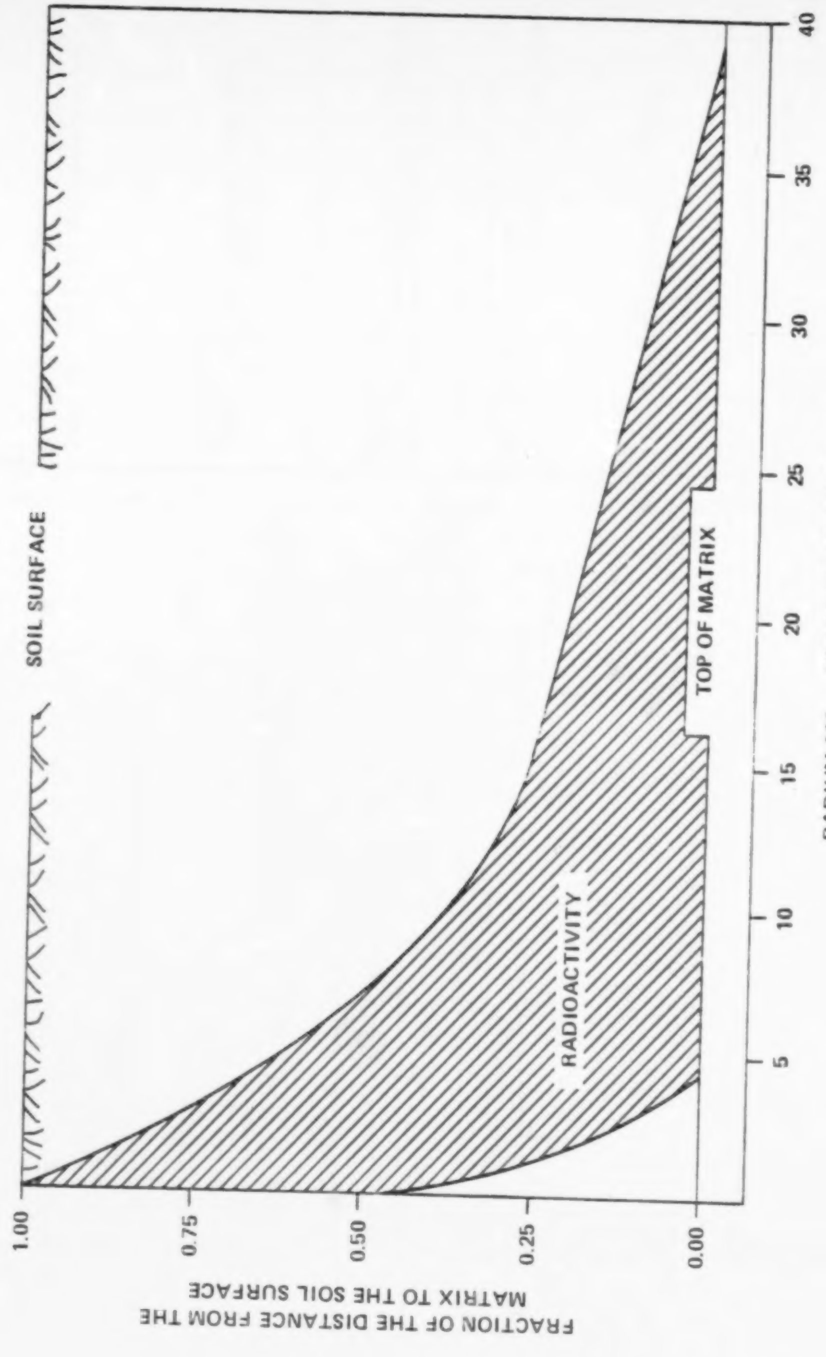
REPRESENTATION OF THE PRODUCTION OF ATMOSPHERIC RADON AND ITS DECAY PRODUCTS

FIGURE 2.9-6


SWIFT CREEK MINE
AND
SUWANNEE RIVER MINE
RECLAIMED LAND CORE
RECLAIMED LAND CORE
SRCC
CORE O-8
CORE N-9
T1S R15E
T1S R16E

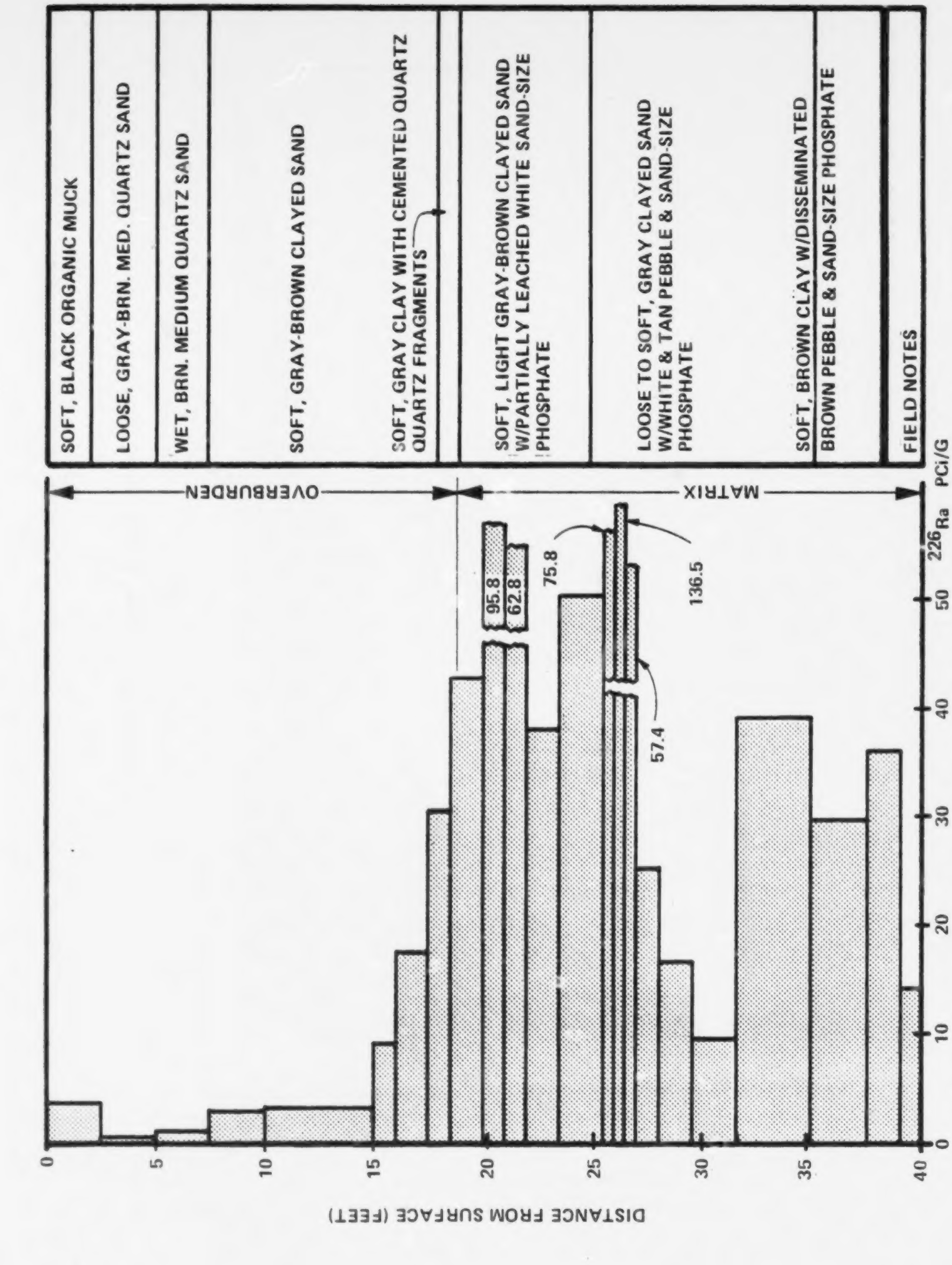
AREAS INCLUDED IN 3-YEAR MINING PLAN FOR OXYCHEM

FIGURE 2.9-7



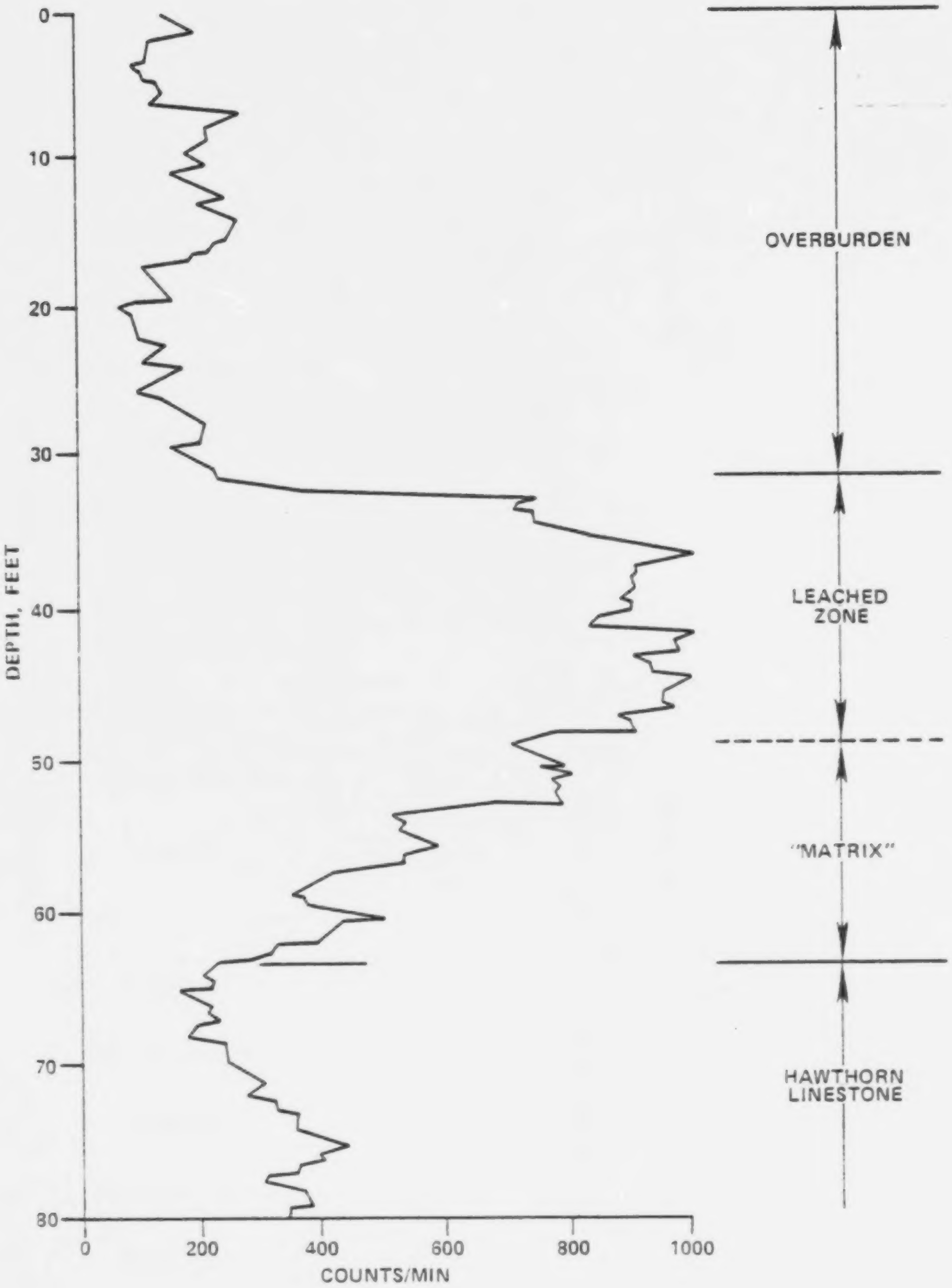
NORMALIZED RADIUM PROFILE FOR UNMINED PHOSPHATE LANDS

FIGURE 2.9-8



PROFILE OF RADIOACTIVITY IN CENTRAL FLORIDA PHOSPHATE REGION HIGH LEACH ZONE

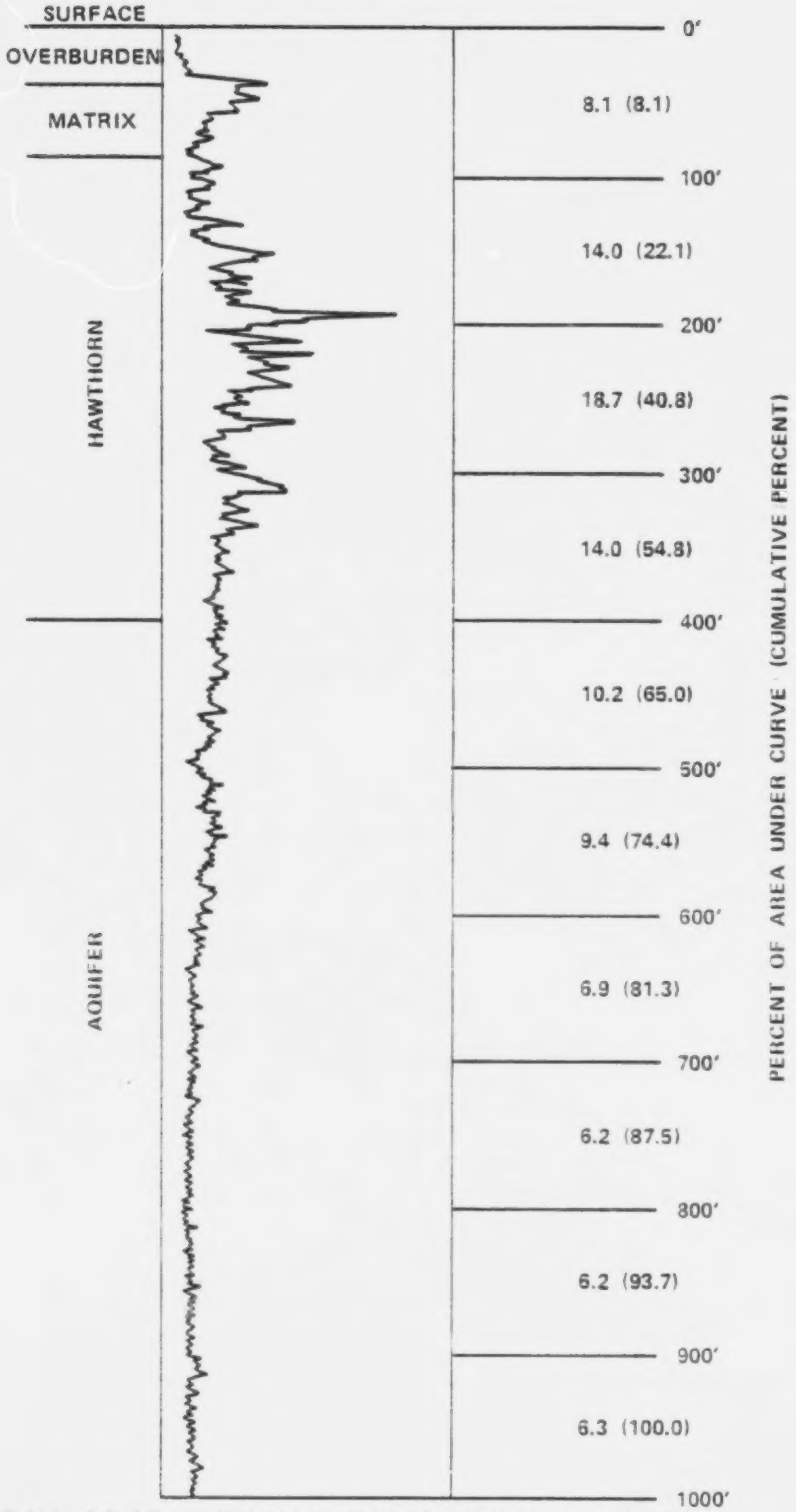
FIGURE 2.9-9



"MATRIX IS THE LAYER MINED. LOG MADE BY THE U.S. GEOLOGICAL SURVEY

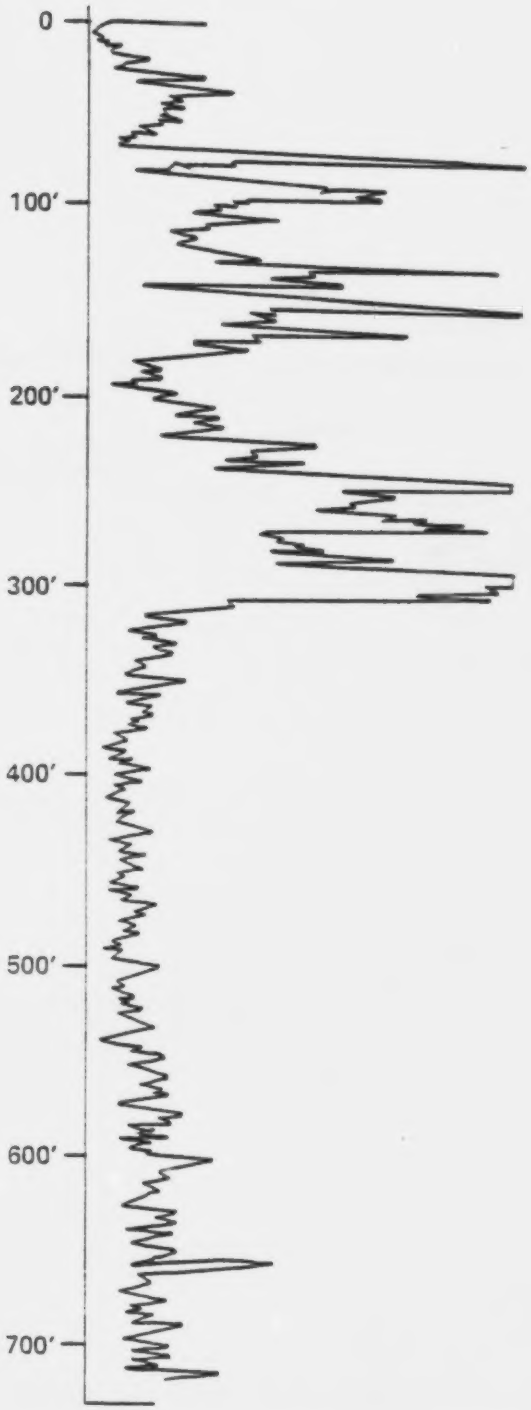
GAMMA-RAY LOG OF AN EXPLORATORY HOLE IN THE FLORIDA LAND PEBBLE PHOSPHATE DEPOSIT

FIGURE 2.9-10



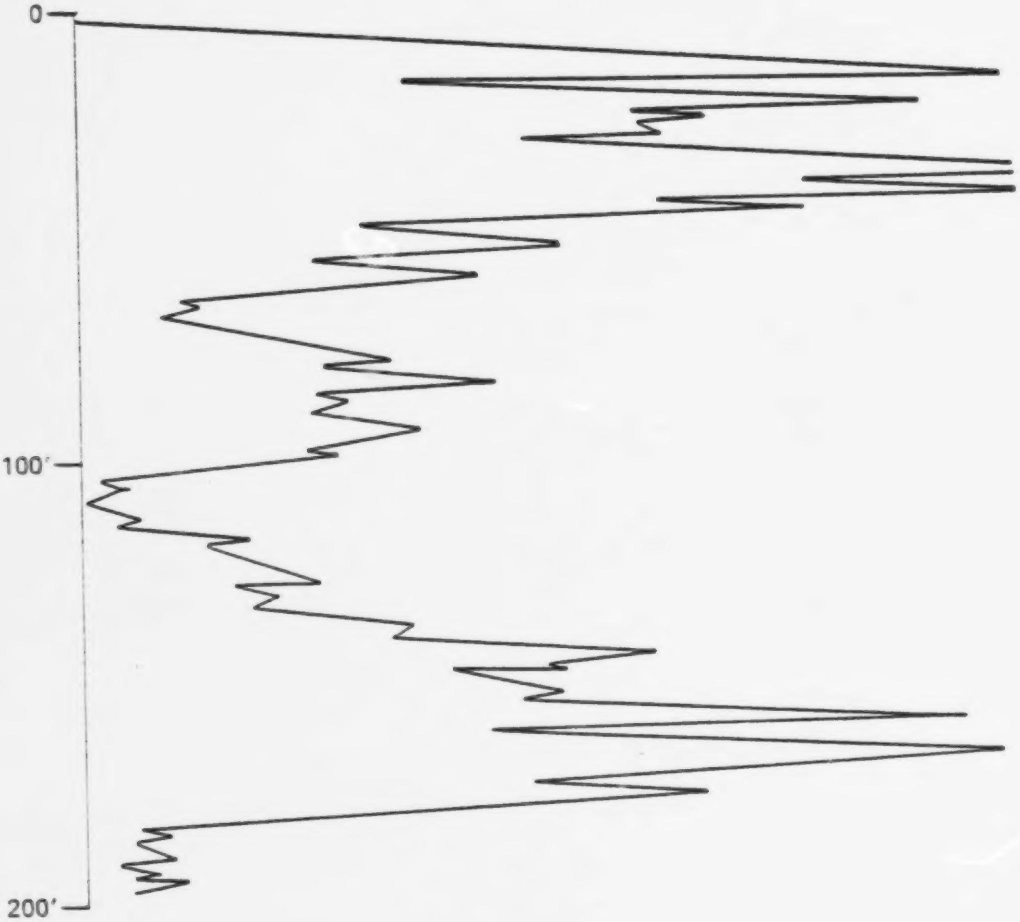
GAMMA-RAY LOG OF A DEEP WELL IN WEST CENTRAL FLORIDA

FIGURE 2.9-11



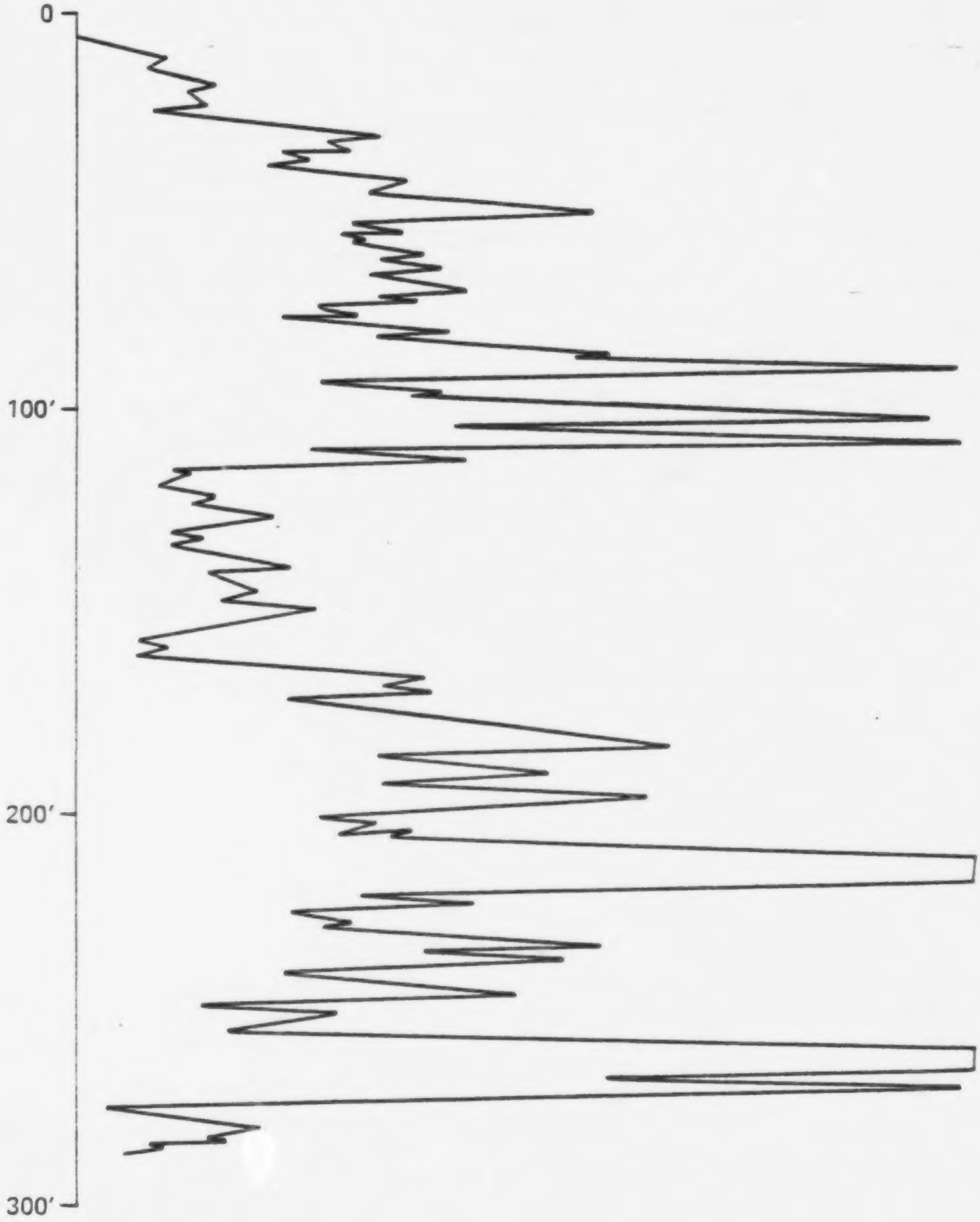
GAMMA LOG, WELL NO. 12 (USGS 301535082162001) SANDERSON OBS (Mi77)

FIGURE 2.9-12



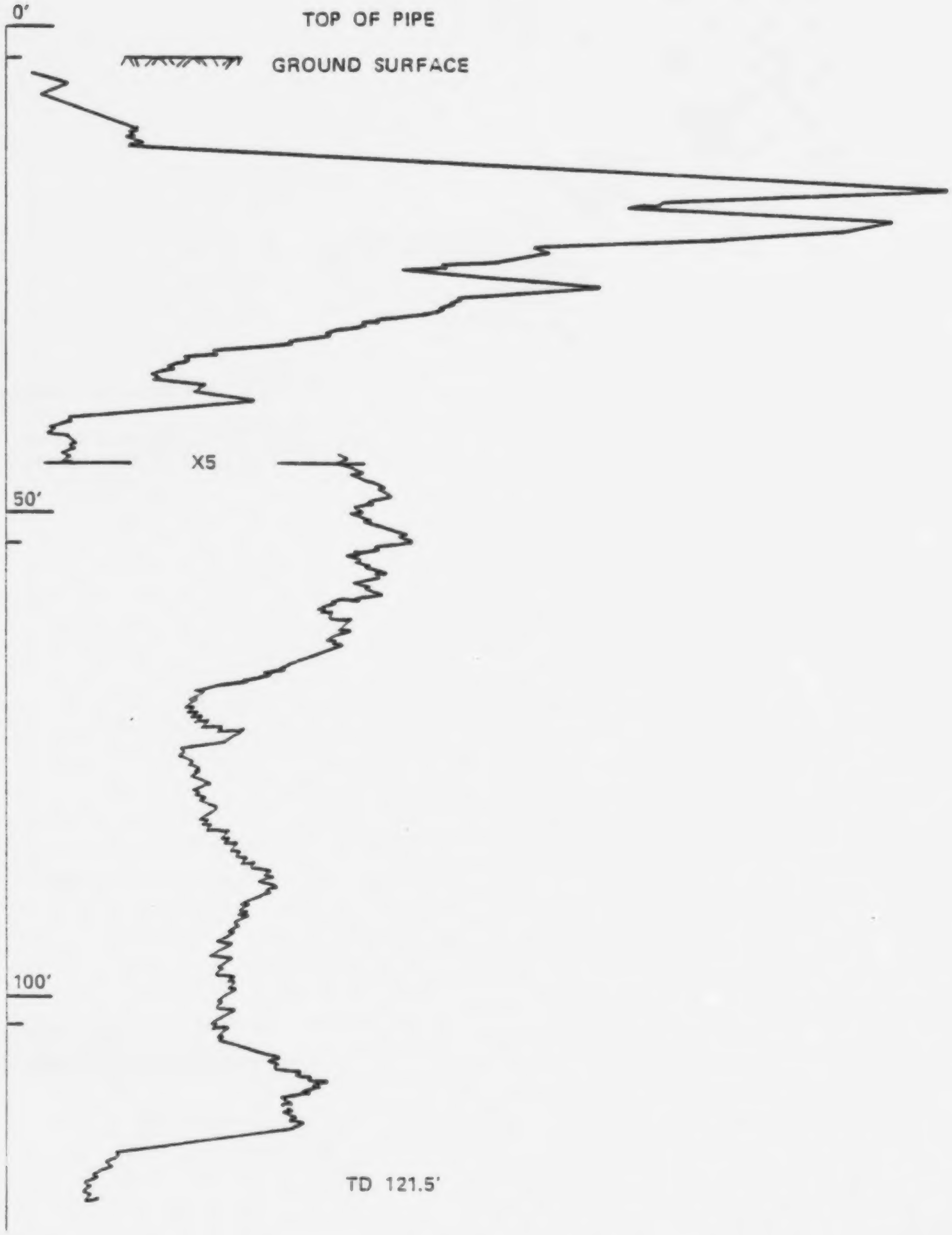
GAMMA LOG, WELL NO. 3A (USGS 302052082312401) ONF-3, FLORIDAN (Mi77)

FIGURE 2.9-13



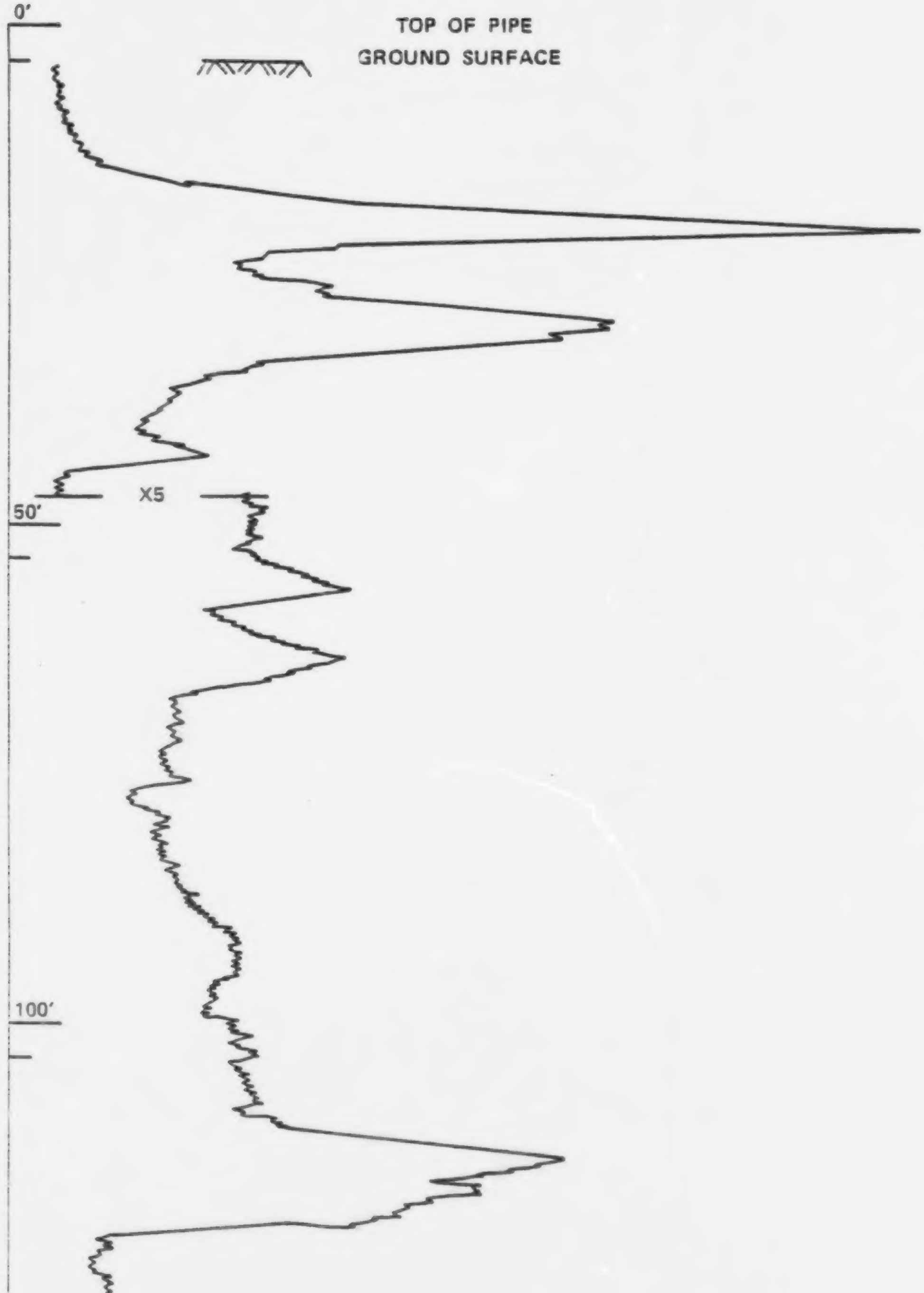
GAMMA LOG, WELL NO. 5A (USGS 302115082232201) ONF-5, FLORIDAN (Mi 77)

FIGURE 2.9-14



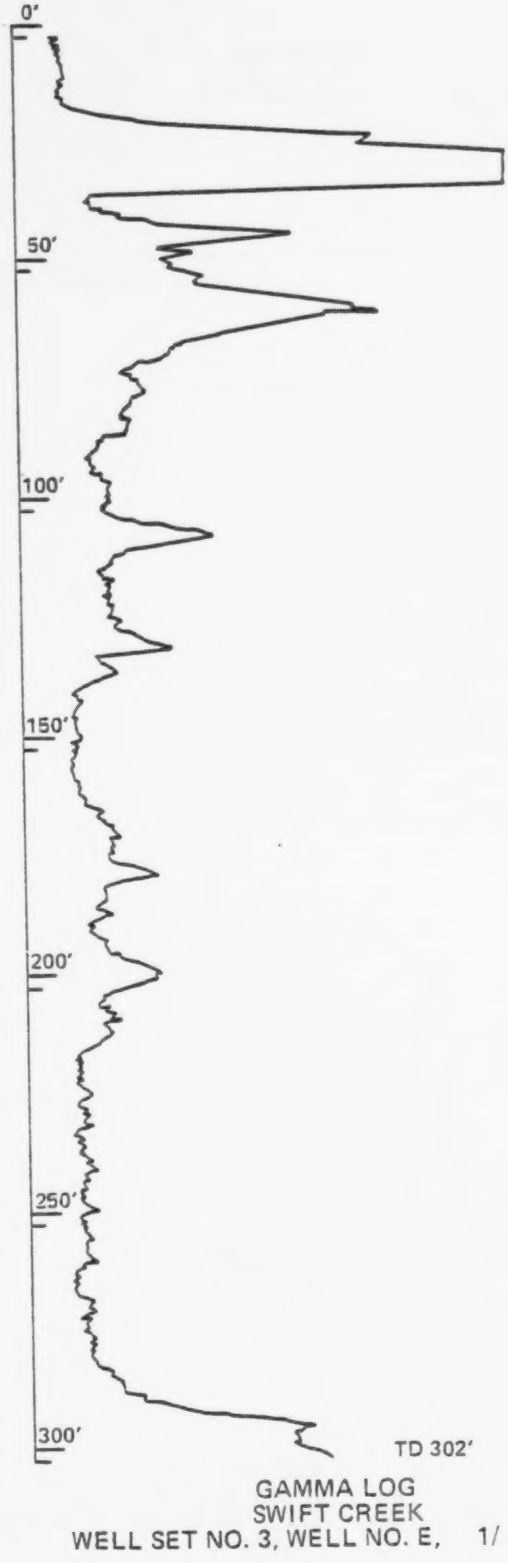
GAMMA LOG
SWIFT CREEK
WELL SET NO. 1, WELL NO. C 3/1/78

FIGURE 2.9-15



GAMMA LOG
SWIFT CREEK
WELL SET NO. 2, WELL NO. C 3/1/78

FIGURE 2.9-16



GAMMA LOG
SWIFT CREEK
WELL SET NO. 3, WELL NO. E, 1/ 3/1/78

FIGURE 2.9-17

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2.10 CULTURAL RESOURCE ASSESSMENT

2.10.1 INTRODUCTION

Early in 1977, preliminary plans were formulated for a cultural resource assessment of lands subject to disturbance during construction of the Swift Creek Chemical Complex (SRCC). To clarify at the earliest possible time the amount of land considered under the NPDES permit to be federally involved and requiring assessment in the resulting EIS, a determination was requested from EPA. In a meeting with the consultant team, EPA advised that lands subject to future mining were not involved and that consideration would be restricted to the area to be occupied by the proposed SRCC.

During the study, boundaries were expanded somewhat to include in the case of the historical study all of Section 35 and 36, Township 1 North, Range 14 East, and Section 1, Township 1 South, Range 14 East. Archaeological field survey requiring two person days of work covered approximately 1000 acres generally bounded by U.S. Hwy 41 on the southwest, existing facilities on the east, and the centerline of Sections 25 and 26 on the north (Figure 2.10-1).

The cultural resource assessment was proposed to insure compliance with federal historic preservation mandates implemented by 36 C.F.R. 800, "Procedures for the Protection of Historic and Cultural Properties."

Four phases were included: collection of background data and project design; historical documents survey; archaeological field survey; and data interpretation and report preparation.

2.10.2 EXISTING INFORMATION AND PROJECT DESIGN

The Florida Master Site File at the Division of Archives, History and Records Management revealed four recorded sites within a six mile radius of the survey area (Figure 2.10-1). The closest site, 8Ha1B, Sanders Mound, is a sand mound located about 1-1/2 miles southeast. Another mound, which has yielded artifacts from the Fort Walton and Weeden Island periods, is recorded as 8Ha1A, the Sandelin site, about 4 miles west. 8Ha25, nearly six miles away, is represented by a surface scatter of flint waste on the River Road, as is 8Ha24 several miles farther east along the road. The last site within the 20 square mile sample area is 8Su30, Suwannee Springs, a National Register site dating to the historic period and located on the Suwannee River at the Hwy 51 bridge.

While this collection of sites is useful in establishing prehistoric occupation in the region and indicating the range of remains which might be expected, it is too small to serve as a reliable base for a predictive model of settlement distribution. Sites were expected, then, on the survey property in almost any location, and no areas could be considered to have low survey priority. Still, certain assumptions were made and acted upon; namely, that locations near water are often preferred, in poorly drained regions local elevation is valued, and, given limitations of time and survey techniques, sites are more likely to be discovered on disturbed ground. This is not to say that they will occur there with greater frequency, but rather that artifact density is sometimes so low, particularly in lithic scatter sites, that post-hold testing may fail to reveal cultural material. It is implied then that surface examination of all disturbed ground will in a given amount of time allow investigation of a larger sample and result in a more reliable model of site distribution.

The investigation was designed to provide data from several sources which have proven valuable in past surveys. Large and small scale black and white aerial photographs from 1947, 1954, 1972, and 1975 were examined for indications of original landscape features, land use patterns, as well as degree of recent disturbances. An historical documentary study was completed to suggest locations of sites with historic significance and to provide a brief review of recent adaptation and exploitation of resources. The archaeological field survey was intended to reveal locations of prehistoric and historic cultural resources evident on the property through standard survey techniques.

2.10.3 HISTORICAL DOCUMENTS SURVEY

A survey of Spanish land grants, state and local documents, county records and nineteenth century maps that pertain to the three sections in the survey area revealed the existence of no primary historic sites.

Extant reminders of the mill town and late nineteenth century lumbering center at White Springs do remain. The location of Camp's Still is presently denoted by a small group of wooden shacks, and portions of the railroad bridge may be found on the site. The criteria for evaluating possible historic sites were those established by the Division of Archives, History and Records Management for eligibility in the State inventory of historic sites and those required for recommendation of sites to the National Register of Historic Places. Both primary and secondary source materials have been compiled in an effort to reveal any historic sites within the planning area.

The present discussion provides a very brief overview of descriptions and events during the eighteenth and nineteenth centuries in East Florida and focuses primarily upon a documentation of the agricultural economy of the White Springs area, the history of local phosphate development, and consideration of the Suwannee River.

Historically, the principal waterway in East Florida, serving both commercial and agricultural pursuits, has been the St. Johns River. The fertility and productivity of the adjacent lands led to cultivation, while its geographic proximity to the Atlantic invited a proclivity for trade, and thus settlement. The vicinity of the St. Johns River was the theater for the first attempts to establish a permanent settlement in East Florida. During the sixteenth century's era of expansion, French colonization efforts gained an early yet transitory command of the St. Johns. In 1562, Jean Ribault led an expedition which discovered the "Riviere de Mai," the St. Johns River. A second French voyage under Laudonnière followed two years later and resulted in the founding of a colony, Fort Caroline. The French tenure was brief, as the Spanish, under Menéndez, ousted them in September, 1565, thus signaling the first Spanish era of asendancy in East Florida.

In 1763, the British assumed the occupance of Florida and created a network for trade over the next twenty years. The travels of John and William Bartram and the survey by Bernard Romans during this period provided the first details of the geography of the area under examination. In his 1765 account of a journey up the St. Johns, John Bartram notes that the topography is comprised of pinelands capable of supporting cotton and potato crops, savannahs producing thick grass where cattle might graze, cypress swamps exhibiting great potential as rice grounds, rich lands between the pines and swamps suitable for the growing of indigo. Bartram comments that:

> of the large cypress trees may be made great quantities of choice shingle, pales, and boards; the prodigous large live-oaks will make excellent strong and durable timbers for shippings, as the tall straight long-leaved pine for masts and yards and the others for turpentine, tar and pitch. . . . (Stork, p. 50)

Half a century later, Charles Vignoles wrote in his 1823 Observations Upon the Floridas, which featured a map denoting "Rich Pine Lands" between the "Suwanee and Oithlacucy Rivers," of the "lower parts of the rivers . . . subject to the very deep and annual inudations, but the whole country from the Georgia line, many miles south from the bluff on the Appalachicola to the banks of the Suwanee is covered with fine rich hammocks, . . ." (Vignoles, p. 55).

By the 1830s the era of steamboating in North Florida had commenced, to be halted thirty years later by Civil War hostilities. "Pioneer North Florida in the years before the Civil War was thinly populated and the landscape was sparsely dotted with small villages and isolated farms. Cotton was the main stay . . ." (Mueller, p. 273). Lumbering quickly evolved as the region's key industry when settlers and Northerner entrepreneurs sought to utilize the prime natural resources of the area. Post-Reconstruction years witnessed the coalescence of milltowns dotted with sawmills. Land availability and productivity coupled with the advent of the late nineteenth century Florida railroad era influenced the burgeoning development of North Florida from 1870 to 1900. Small centers of population evolved with the birth and maturity of the logging industry. Demographic and economic patterns began to emerge. "The value of the products of the industries dependent upon the forests--including lumber, tar, turpentine and shipbuilding--amounted to $18,897,495 or nearly 50 percent of the total manufactures of the State in 1900" (Kerick, p. 314). The population growth rate in Hamilton county, Florida, paralleled the expansion of lumbering interests. Hamilton county embraced 553 residents in 1830; by 1870, the population had jumped to 5,749 persons. By the first decade of the twentieth century (1910) Hamilton county population totalled 11,825 (Culter, p. 588). Rail lines of the Georgia Southern and Florida Railroad began to track this north central region by the 1880s; in 1899, several lines had merged to form the South Florida and Western Railroad Company (Cutler, p. 285).

Minimal railroad construction occurred in Florida before the Civil War. Overland roads also remained few in number and low in quality. Persons living in north Florida, the only area settled heavily during antebellum years, who wished to market agricultural crops (primarily cotton and tobacco) depended heavily on river traffic. Plantations and settlements tended to arise along waterways and at junctions of waterways and the few existing railroads and major roads. Rivers also provided commercial routes for incoming goods and served as transportation routes for those wishing to travel within or out of the state. Steam powered vessels were active as early as the 1840s. Economic recovery came slowly to post-war Florida; railroad construction resumed only in the 1880s. Even then, rivers and streams often provided the best route from farms to railheads which took the place of ports as commercial centers. Only in the 20th century did these conditions alter. The socio-economic importance of river commerce and transportation to Florida during the intervening decades cannot be overemphasized.

The Suwannee River rises in the Okefenokee Swamp area of Georgia. Joined by the Alapaha River in Georgia and the Withlacoochee River in Florida, it runs into the Gulf of Mexico just north of Cedar Keys. In antebellum years, land along its route yielded primarily cotton and tobacco as market crops. After 1865, lumber--pine, cypress, and cedar--became the major market product of those areas.

The Suwannee presented problems to those wishing to move freight up and down its reaches. Oyster bars and reefs blocked the mouth of the river, and its shallow course often was obstructed in various ways. Activity by the United States government while Florida still was a territory (pre-1845) focused on clearing a channel into the Gulf at the river's mouth (U.S. 27th Cong., 3rd Sess. House Doc. no. 78, pp. 2-6). Steam powered vessels with shallow drafts could use the river, as could barges and rafted log floats, but encumbrances presented constant problems.

Late in the 1870s, congressional action ordered the dredging of a channel at the river's mouth and the clearing of obstructions from its route as far as Ellaville; this clearing later was extended to New Branford. Careless lumbermen floated unrafted logs on the river, and sawdust, slabs, and edging from mills also clogged its course (U.S. 50th Cong. 1st Sess. 1887, p. 1255). Traffic on the river in the 1880s and 1890s by and large carried trade from river towns to the railroads at New Branford and Ellaville.

Only cedar timber was floated or carried to the Gulf (50th Cong. 1st Sess., 1887, p. 1254). Trade increased on the river as the Corps of Engineers progressed in their dredging and clearing project. Naval stores, farm produce, freight for use by inlanders, and of course lumber continued to be the major commerce (U.S. 54th Cong. 1st Sess. 1895, p. 1559). Persons living and working in the project area, which is close to but not on the Suwannee River, doubtless were among those dependent on that river for commerce and transportation. Only 20th century road construction altered that situation.

The center of Florida'a phosphate industry--still less than a century old--lies far south of the project area. At no time were the limited phosphate deposits of Hamilton County a focal region of that industry's activities.

In the mid-nineteenth century, the useful properties of phosphate began to be realized. Industry and agriculture soon became dependent on a ready supply of that mineral. The first mines appeared in England in 1847. Less than forty years later, testing in Florida located useful deposits of phosphate. By 1890, numerous mines

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* The Florida Phosphate Industry: A History of the Development and Use of a Vital Mineral, written by Arch Frederic Blakey and published by Harvard University Press, Cambridge, Mass., in 1973, is the source for all data on that industry where no other sources are indicated.

already had appeared in central and south Florida. These events coincided with decades of change in American agricultural techniques as use of machinery and "scientific farming" became necessary to solve labor problems and increase yields. Use of fertilizer, a major phosphate product, played an important part in those changes.

Florida's phosphate industry underwent three developmental stages, the first of which began with the discovery of the mineral in the late 1880s and ended after World War One. Land speculation, a boom period, and years of prosperity preceded the difficulties of war time. The middle phase (c. 1920-1940) produced adjustments to the depression years and to technological advances. The third phase of development (1940-present) brought about an expanded industry and a multiplicity of technological changes. Florida offers four types of phosphate: hard rock, soft rock, river pebble, and land pebble. Hamilton County, in which the project area is located, contains primarily deposits of the last type. The initial "speculative frenzy" (Blakey, p. 48) following the late 1880s discovery of hard rock phosphates failed to spread to the land pebble region. Only in the early 1900s did land pebble deposits come to the fore. Today land pebble phosphate accounts for almost all phosphate produced in Florida.

In 1913-14, a long article on "The Pebble Phospahte of Florida" appeared in an annual report of the Florida Geological Survey. The author made two brief references (Sellards, pp. 38, 83) to Hamilton County deposits which he described as limited and as being located north and west of Jasper, the centrally located county seat. A map included in a 1942 United States Geological Survey bulletin (Mansfield, Plate 1) depicts Florida's phosphate regions as revealed by 1890 census information. It indicates a hard rock region lying in Hamilton County northwest of Jasper. Another map in that publication (Plate 5) indicates a 1940 interpretation of the location of phosphate deposits in Florida. A hard rock area is illustrated as mid-county with an "outlying pebble area" in the county's northwest sector. Most of the eastern half of the county and a good portion of the western half are described as areas "in which Hawthorn formation of Miocene age is exposed". Estimates made in 1935 concluded that Hamilton County contained 62,000 acres of land pebble-bearing earth. The greatest single concentration in the county included about 14,000 acres (Thomas, p.6). A 1970 map contained in a recent publication (Blakey, Map 1, opp. p. 104) indicates only land pebble deposits in the eastern third of Hamilton County.

In the mid-1960's Occidental Petroleum Corporation opened a new phosphate plant (Suwannee River Mine) ten miles east of Jasper (The Jasper News, November 6, 1964). In subsequent local news articles discussing this much needed boost to Hamilton County's economy, no mention occurs of past phosphate mining in the county. This omission perhaps indicates that the mining which did occur there late in the 19th and early in the 20th centuries failed to make an impact on folk memory.

In 1892, United States Corps of Engineers personnel reported that "beds of phosphate rock have been discovered along the upper [Suwannee] River" (U.S. 52d Cong. 2d Sess. House Ex. Doc. 1, pt. 2, p. 1393). The next year several mines along the lower Suwannee were reported (U.S. 53d Cong., 2d Sess. House Ex. Doc. 1, pt. 2, p. 1680) but no further mention of upper river deposits occurred in that or following Engineers' reports. Subsequent reports describing commerce along the Suwannee indicate that although fertilizer, a major phosphate product, regularly was freighted to Cedar Key by river traffic, the volume of that trade remained very low compared to the annual volume of trade in phosphates in central and south Florida. [Example: in 1894, 98,000 long tons of land pebble phosphate were produced in Florida (Blakey, Appendix C, Part II, p. 154); in that same year, thirty-five tons of fertilizer travelled the Suwannee River (U.S. 54th Cong., 2d Sess., House Exec. Doc. 1, pt. 2, p. 1559)]. Fertilizer was finely gorund phosphate rock or pebble with or without additives (Blakey, p.2).

As the above information indicates, developments in the phosphate industry have certainly affected portions of Hamilton County but that impact has not been great. In depth research might reveal some specific data about phosphate industry activities in or near the project area. For example, near the project area is a local landmark called Camp's Still. The C. and J. Camp Company involved itself extensively in both the lumber and the phosphate industry (Blakey, pp. 78, 91). Often phosphate processers cut timber on the surface for use as fuel and lumber for mines on the same property (Blakey, p. 50 and note 68, p. 178).

Also, land transactions in the project area occurred at times which may reflect some of the event described above. Some of the land in the sections affected passed out of state hands before 1880. However, significant property transfers occurred in 1892; the first shipment of land pebble phosphate from Florida took place the previous year. Another set of transactions occurred at the end of the 1900s decade. By that time it was clear that lumber would outweigh phosphates in importance in Hamilton County's economy.

The following section delineates the geographic terrain and physical topography for the project area as revealed by surveyors' field notes. The plat map and field notes for Township 1 South, Range 14 East, as recorded by Surveyor Christopher Stone in 1824-25 indicate two ponds lying along the eastern boundary line admidst the pine flats and cypress land (Field Notes, vol. 5, Township 1 South, Range 14 East, p. 146). Stone notes an Indian path 19 chains south along the third mile of the eastern boundary, and a spring 58 chains south on the same course--hammock and pine flats characterize the eastern line (ibid.) "Pine timber, 3rd rate," covers the area, according to Stone. No evidence of sites within the Northeast quarter of Section 1, Township 1 South, Range 14 East was uncovered by present research.

The interiors of Sections 36 and 35 of Township 1 North, Range 14 East were surveyed in 1831 by Henry Washington and George Willis. The exterior lines of the township were surveyed by C. C. Stone in 1825. Stone documents 2nd rate pine timber along the first mile north on the eastern boundary of Township 1 North, Range 14 East (Field Notes, vol. 5, p. 276). Cypress swamps at times interrupted by hammock land cover the remainder of the course.

An Indian path 17 chains along the 4th mile running north on the eastern boundary of the township was located by the surveyor (ibid.). In 1831 Surveyor Henry Washington's records indicate no evidence of primary historic sites. Timber is generally recorded as "flat 3rd pine" (Field Notes, vol. 27, p. 57). Cypress and bay ponds, surrounded by heavy timber lands, predominated.

Local records pertaining to the subject tract were found in the Hamilton County Courthouse at Jasper. Deed records and assessment rolls provided information supplemental to the tract book entries. The latter ascribe ownership of Section 1, Township 1 South, Range 14 East to George C. Rixford as of November, 1879 (Tract Book, vol. 13). Records show that a 480 tract area, the N^2 and N^2 of SE^4 of Section 1, was deeded by 1892 to W. H. Raulenon (Tax Rolls, 1892, Hamilton County). By 1908, all of Section 1, assessed for a $640 value, had been transferred to A. M. McLaughlin and Company. A reference to McLaughlin in Deed Book X, page 396 states, ". . . and east of the Atlantic Coast Line Railroad, yet to be cut, and estimated to be cut, 8 crops of boxes, together with all the tools, implements, feed stuff, crude products and all supplies. . . belonging to Smith and McLaughlin place." Ownership of Section 1 passed from McLaughlin to J. R. Sandlin in 1913 (Tax Rolls. 1913, Hamilton County) and subsequently, in 1915 to Thompson and Jackson (Tax Rolls, 1915, Hamilton County). By 1922 Section 1, incorporated with adjacent Sections 36 and 35, was owned by J. A. Corbett and Company (Tax Rolls, 1922, Hamilton County) and valued at $1,300.

A similar pattern of property ownership prevailed for Sections 35 and 36, Township 1 North, Range 14 East as uncovered in the deed records and assessment rolls for Hamilton County. The tract book entries indicate the following: a Tallahassee District Patent #9 issued July 6, 1857 and recorded November 19, 1879 shows the North half of Section 35 containing 319.7 acreas ascribed to John S. Hink and James H. Parker; the southern half was deeded to the Pensacola and Atlantic Railroad on April 17, 1883 (Tract Book, vol. 13). The entries pertaining to Section 36 indicate identical ownership (ibid.). In 1892 the property was conveyed to W. C. Jackson (N^2 of Section 35 and S^2 of Section 36) and J. Maulden (S^2 of Section 35 and N^2 of Section 36) (Tax Rolls, 1892, Hamilton County). The 1901 assessment rolls ascribe all of the two sections to J. R. Tulen. By 1908, J. R. Sandlin acquired the three section parcel. Sandlin purchased 5,000 acres including Section 35 west and south of the Georgia Southern and Florida Railroad right-of-way, all of Section 36, and those portions of Section 1 West and South of the Georgia Southern right-of-way (Deed Book X, p. 396, Hamilton County). This property transaction included the following notation which illustrates the character of a lumber farm:

> Also, one turpentine farm partly situate on the above described land known as the Smith and McLaughlin place, situate at B-190 mile post on the Georgia Southern and Florida Railroad in Hamilton County, Florida, consisting of one turpentine still and fixtures; one steam pump and fixtures; three crops of virgin boxes; . . . six crops of yearling boxes; three crops of pulling boxes; together with all the timber and turpentine boxes now being worked at said place; nineteen chanties for hands; 2 dwelling houses for white people; one two-horse wagon and harness and 22,000 acres, more or less, of timber situate on the above described land. . . . (Deed Book X, p. 396, Hamilton County)

In 1914 Sandlin sold an extensive tract surrounding these three sections to the Dixie Turpentine Company, and by 1922 the three section parcel was obtained from Sandlin by J. A. Corbett and Company (Tax Rolls, 1922, Hamilton County).

Although County records for Sections 36, 35 and1 do not reveal that the area was owned outright by the R. J. and B. F. Camp Lumber Company prior to 1922, the region surrounding the wooden shacks still standing in Section 1 is known as Camps Still. The still was closed in the early 1930s according to recent informants. The Camp Lumber Company, however, owned extensive acreage in North Florida. Records indicate a 1901 transaction in which R. J. Camp of South Hampton, Virginia purchased 8,012 acres in Township 1 North, Range 15 East (Deed Book R, p. 432, Hamilton County).

The foundation of the lumber manufacturing business carried on by the Camp Manufacturing Company, the White Springs Lumber Company and the R. J. & B. F. Camp Lumber Company was laid in 1876 when Paul D. Camp began the manufacture of North Carolina pine near Franklin, Virginia on a scale that reached 1,500,000 feet annually ("Pine Products of the Atlantic Coast, "American Lumberman, June 15, 1907). Subsequently, the Camp Manufacturing Company was launched on April 1, 1887; from the realized profits, the company expanded to embrace lands near White Springs, Florida in 1897 (ibid.). The Camp lumber interests were widespread and included the company headquarters at Franklin, Virginia, mills at White Springs and Carrabelle, Crystal River and Dunnellon, Florida, and the Albion Mining and Manufacturing Company, which operated phosphate mines (ibid.). The White Springs plant, completed in 1897, included a saw mill, planing mill, dry kiln and storage sheds. The Seaboard Air Line and Georgia Southern Railroad connections provided the requisite links to Northern lumber markets.

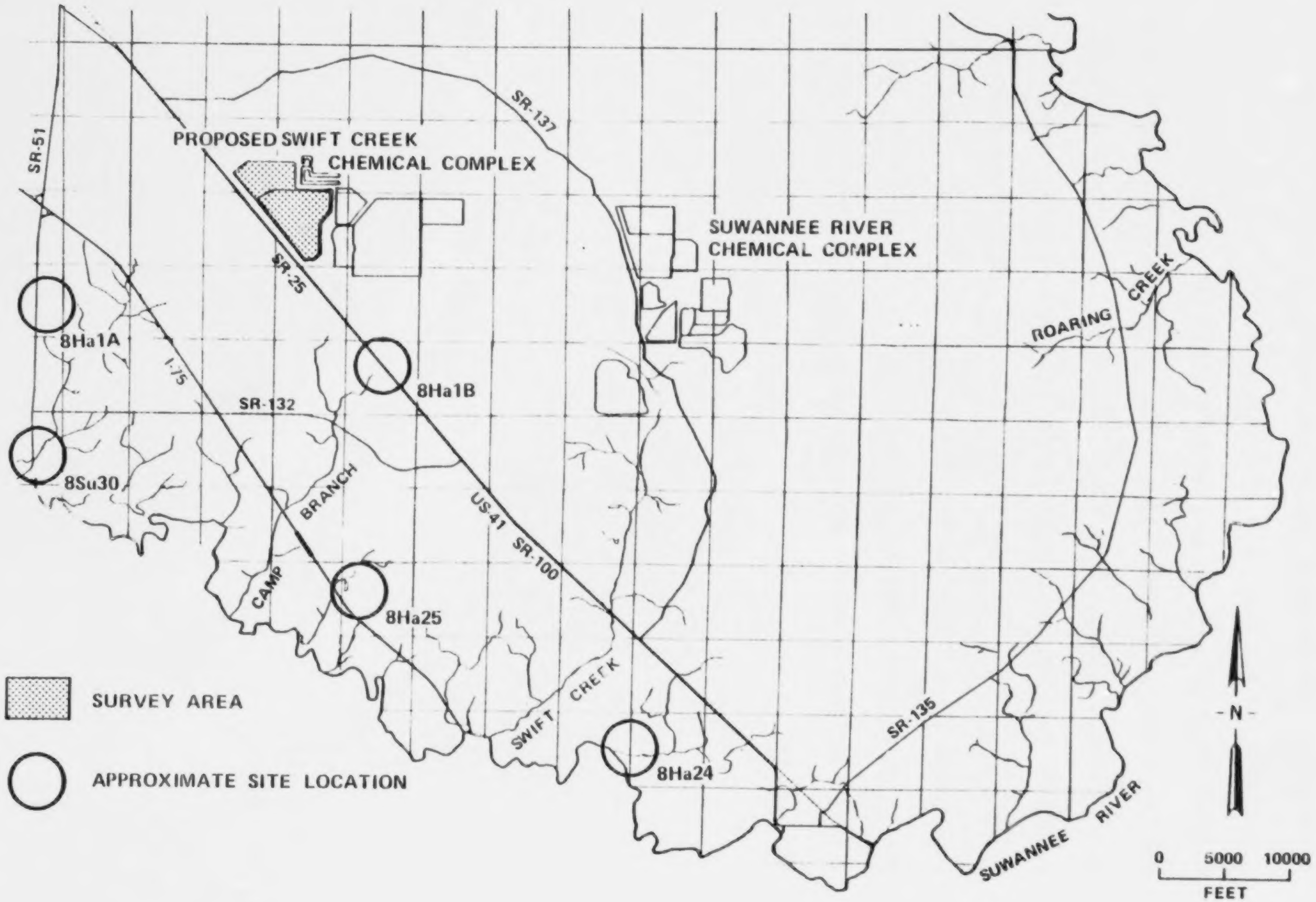
In summary, a field check of the records and documents pertinent to Section 1 Township 1 South, Range 14 East and Sections 35 and 36 Township 1 North, Range 14 East discloses two extant historical sites of secondary significance, portions of a railroad bridge and wooden structures at Camp's Still, which likely date from the turn of the century. These structures are significant, because they represent, along with several other nearby components, the legacy of the once booming logging industry of North Florida in the late nineteenth century.

2.10.4 FIELD SURVEY

By the beginning of the field survey it was already recognized that most of the proposed SCCC tract had been severely disturbed. Some strip mining had occurred and much of the land has been clear-cut in preparation for continued mining. Large drainage ditches, roads, railroad beds, and a power line right-of-way have all accounted for significant modification of the landscape, but have also provided large areas of exposed soil for examination.

Planted pine plantations make up the remaining dry land; during site preparation, most of the cypress ponds were encircled and penetrated by bulldozer to alter drainage. According to recent aerial photography, the 900-acre tract is approximately 10 percent strip mined; 20 percent is cleared for mining; 8 percent is industrially developed; and 15 percent is taken up by rights-of-way. The remaining 460 or so acres are in planted pines and ponds.

The property was surveyed for archaeological sites by walking or slowly driving all available soil exposures and digging test holes in areas considered to have site potential, such as pond margins and low rises. Altogether some 9.9 miles of roads and rights-of-way were walked. Although only about 300 acres is required for plant and pond construction, a somewhat larger area was actually surveyed. The extra property was examined so that a larger sample area might be considered to increase reliability of results, and to allow clearance for secondary and attendant impacts, such as transportation and utilities rights-of-way. No archaeological sites were revealed during the survey.


PROPOSED SWIFT CREEK
CHEMICAL COMPLEX
SUWANNEE RIVER
CHEMICAL COMPLEX
SR-51
SR-137
SR-25
SR-132
I-75
US-41 SR-100
SR-135
8Ha1A
8Ha1B
8Su30
8Ha25
8Ha24
CAMP BRANCH
SWIFT CREEK
ROARING CREEK
SUWANNEE RIVER
SURVEY AREA
APPROXIMATE SITE LOCATION
N
0
5000
10000
FEET

CULTURAL RESOURCE SURVEY– OCCIDENTAL CHEMICAL COMPANY

FIGURE 2.10-1

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2.11 ENVIRONMENTALLY SENSITIVE AREAS

2.11.1 RIVERS AND STREAMS

The Suwannee River has been considered for designation as a Wild and Scenic River (USDI, 1974) and efforts have been initiated (meeting at Suwannee River Water Management District, April 1978) to consider its designation as an "Outstanding Florida Water". Opinions have been expressed both in support and in opposition to the proposed designations and as yet neither issue has been resolved.

2.11.2 MARSHLANDS, WETLANDS AND ESTUARIES

Created marshlands occur within the five-mile project radius as settling areas associated with phosphate recovery. The previously established vegetation in a clay settling area is lost as water and clays are pumped into the area. This process initially results in a predominantly open water system. As the depth of water decreases with the deposition and accumulation of clays, aquatic macrophytes become established. As the settling area dewaters further, the system changes rapidly into a dense willow stand.

During the early open water and early aquatic macrophyte stage, settling areas support dense populations of waterfowl, shore and wading birds, and raptors. During later stages, especially the willow stage, settling areas only support a few species. The capacity of the settling areas during early stages to support these wildlife populations would enable them to be classified as sensitive areas. However, because the settling areas are transient and because new, active settling areas are continually formed in the phosphate recovery process, water habitat is not lost; it is relocated periodically. These marshlands are, therefore, not considered as environmentally sensitive.

Forested wetland communities within the five mile project area (Fig. 2.11-1) and Swift Creek watershed (Fig. 2.11-2) consist of cypress heads, bayheads and mixed hardwood swamps. Most of these forested wetlands develop in small, seasonally flooded depressions within the pine flatwoods system. Such wetlands are physically isolated from natural surface water drainage systems. They are periodically logged and, as a result, consist of relatively young stands of trees. They provide food, nesting and escape habitat for several animal species and are abundant within north-central Florida and south Georgia. These areas are not considered environmentally sensitive.

Several other forested wetlands within the five-mile project area are large; they are seasonal contributors to surface streams. The largest of these areas are Swift Creek Swamp and Bee Haven Bay which drain to Swift Creek and Rocky Creek, respectively. Both have been logged in the past and Swift Creek Swamp has been affected by current phosphate operations. They, as well as most similar area in the region, may provide habitat for several observed and expected rare and endangered species which include: Black bear, Round-tailed muskrat, Mink, Weasel, Big brown bat, Big earred bat, Hoary bat, Sandhill Crane, Wood Stork, White Ibis, Least Bittern, Many-lined salamander, Alligator and the Carpenter frog (Section

2.7.5.2). A Black bear was trapped in Bee Haven Bay during 1976 and one was killed there during 1977 (S. Stafford, Florida Game and Fresh Water Fish Commission, personal communication). Sandhill Cranes have been observed in Pinhook Swamp and Impassable Bay, two areas similar to Bee Haven Bay (Williams and Phillips, 1972; Steve Adams, personal communication). These areas are comparable in sensitivity and quality to those discussed in the Osceola Forest mining impact analysis (NFWL, 1978), only those areas associated with Swift Creek could be affected by the proposed action. There are no estuaries within the five-mile project area.

2.11.3 UPLAND FORESTS

Of the upland forest types within the five-mile project area (Sections 2.7.3.1.1 and 2.7.3.1.2) only the southern mixed hardwoods may reasonably be considered as potentially environmentally sensitive. Any special consideration for this forest type would be based upon its relative value to the total upland community of the area, its high diversity, and small area acreage as a locally occurring community type.

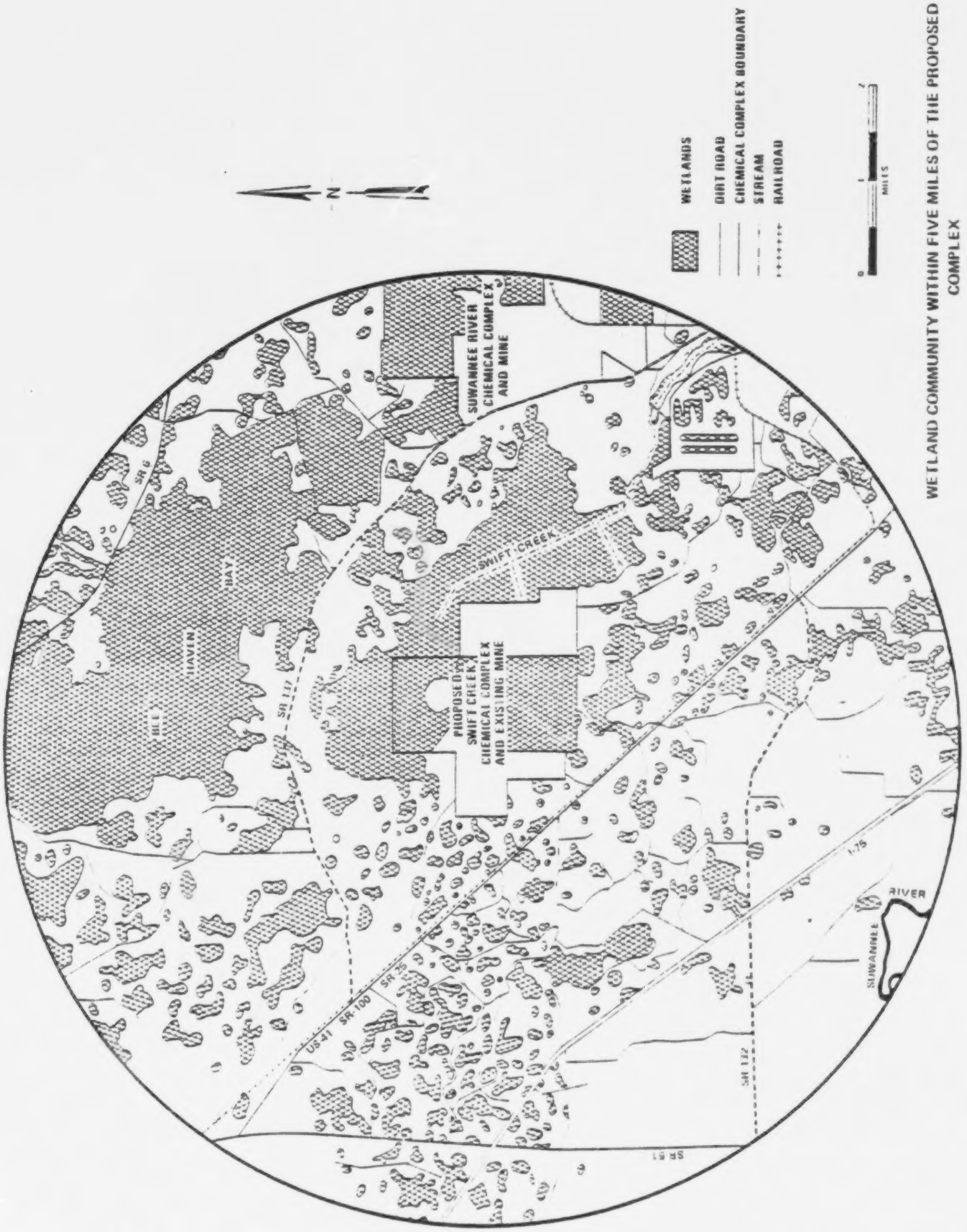
2.11.4 PRIME AGRICULTURAL LAND

Prime agricultural land may be defined as "land suited for producing food, feed, forage, fiber and oil seed crops, and has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops economically when treated and managed with modern farming methods (J. Heard, ASCS, personal communication, 1978). In general, they are the lands which produce the most with the least amount of energy.

Of the various soil associations found within the area of concern (Section 2.7.1.2.3), the Arredondo, var.-Alaga-Kenney and the Chipley-Albany-Plummer associations are best suited for productive cropland or pasture. While their soil potentials under high level management are rated as moderate (Florida Division of State Planning, 1973), they are among the best agricultural soils in the county. Within the area of concern, they are found exclusively in the lower, better drained portions of the Swift Creek basin and along the Suwannee River. Virtually all of these soils have been developed for agricultural use (Section 2.7.1.2.3). No agricultural development or suitable productive soil types are found within the proposed plant site.

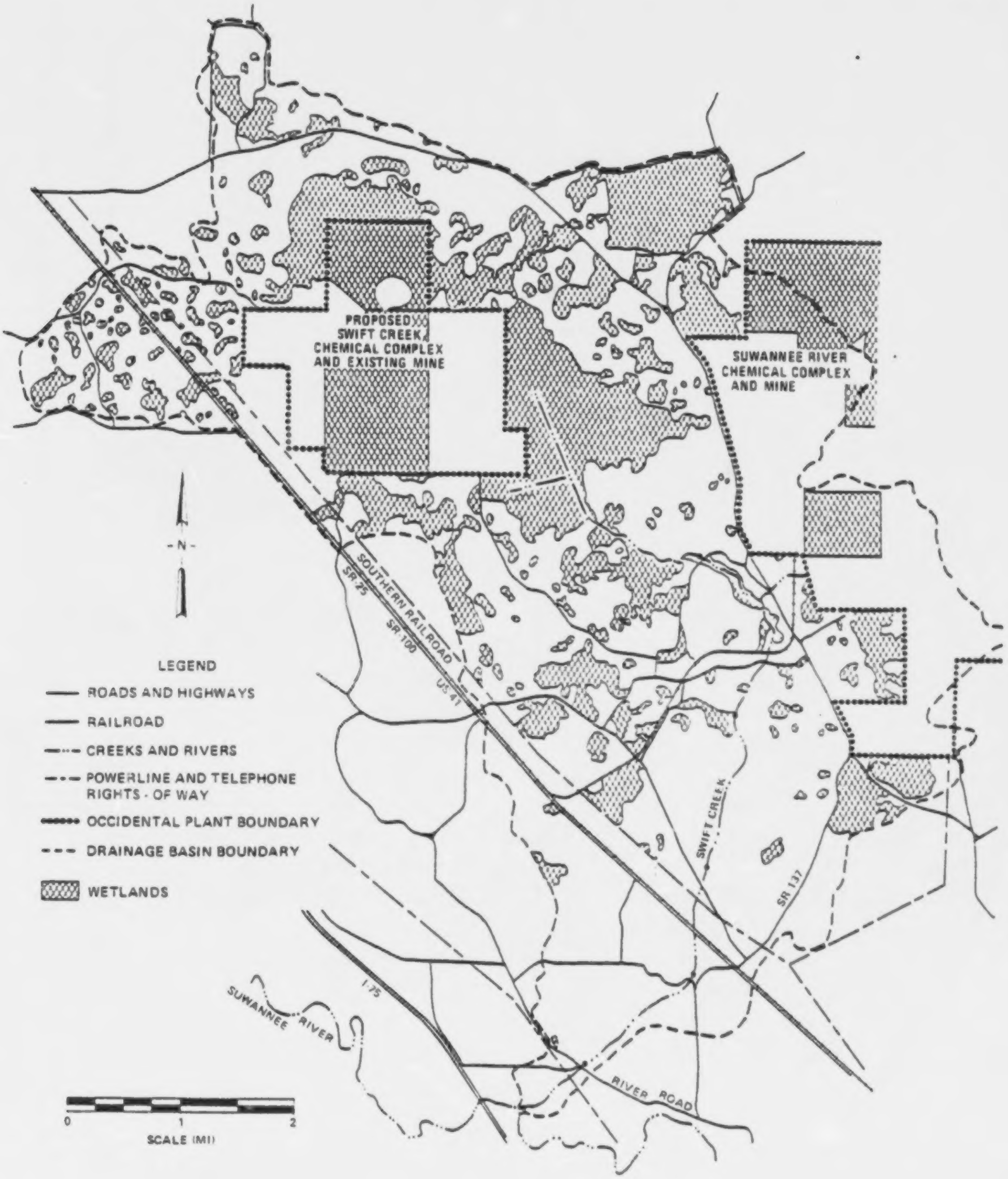
2.11.5 HABITATS OF RARE AND ENDANGERED SPECIES

The total habitat requirements for all considered rare and endangered species (Section 2.7.5.2) spans every habitat type within the study area and this includes artificial habitats that are present as a result of mining, particularly settling areas. Some of these species, such as the Southeastern weasel and Florida panther, are non-habitat specific and potentially all habitat types within the study area should be considered as habitat for rare and endangered species. Other species may require very specific habitat types with a narrow range in variability of components of the habitat. Examples of this include roost site selection in Gray bats or actual habitat in the case of Red-cockaded Woodpeckers (Section 2.7.5.2). Perhaps the most important habitat types, in terms of support of rare and endangered species, are semi-aquatic and aquatic areas. These habitats range from marshes and small ponds (wetlands) to spring runs and moderate to swift rivers. Also included in these aquatic and semi-aquatic areas are artificial habitats which are a by-product of the mining process. Settling areas in the study area provide habitat for at least five species of rare and endangered birds that might not otherwise occur in the area. Aquatic and semi-aquatic areas provide habitat for approximately 16 species of birds, all five fish species, and several mammalian, amphibian, and reptile species (see specific accounts, Section 2.7.5.2, for habitat type). In terms of potential rare and endangered habitat, woodland areas such as Southern mixed hardwoods and hardwood swamps are important, with high pinelands and pine-palmetto flatwoods being next in order of importance. For rare and endangered plants, the highest priority of habitats are edge or ecotone areas and wetlands in pine flatwoods. These habitats are locally and regionally common to abundnat and are usually modified to some extent by forestry and agricultural practices.


N
WETLANDS
DIRT ROAD
CHEMICAL COMPLEX BOUNDARY
STREAM
RAILROAD
0
1
2
MILES
SUWANNEE RIVER CHEMICAL COMPLEX AND MINE
PROPOSED SWIFT CREEK CHEMICAL COMPLEX AND EXISTING MINE
SWIFT CREEK
BEE HAVEN BAY
SR 6
SR 137
US 41
SR 100
SR 25
SR 132
I-75
SUWANNEE RIVER
SR 51

WETLAND COMMUNITY WITHIN FIVE MILES OF THE PROPOSED COMPLEX

FIGURE 2.11-1


PROPOSED SWIFT CREEK CHEMICAL COMPLEX AND EXISTING MINE
SUWANNEE RIVER CHEMICAL COMPLEX AND MINE
N
SOUTHERN RAILROAD
SR 25
SR 100
US 41
SWIFT CREEK
SR 137
I-75
SUWANNEE RIVER
RIVER ROAD
LEGEND
ROADS AND HIGHWAYS
RAILROAD
CREEKS AND RIVERS
POWERLINE AND TELEPHONE RIGHTS - OF WAY
OCCIDENTAL PLANT BOUNDARY
DRAINAGE BASIN BOUNDARY
WETLANDS
0
1
2
SCALE (MI)

WETLAND COMMUNITY WITHIN THE SWIFT CREEK WATERSHED

FIGURE 2.11-2

LIST OF REFERENCES
(Section 2.11)

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